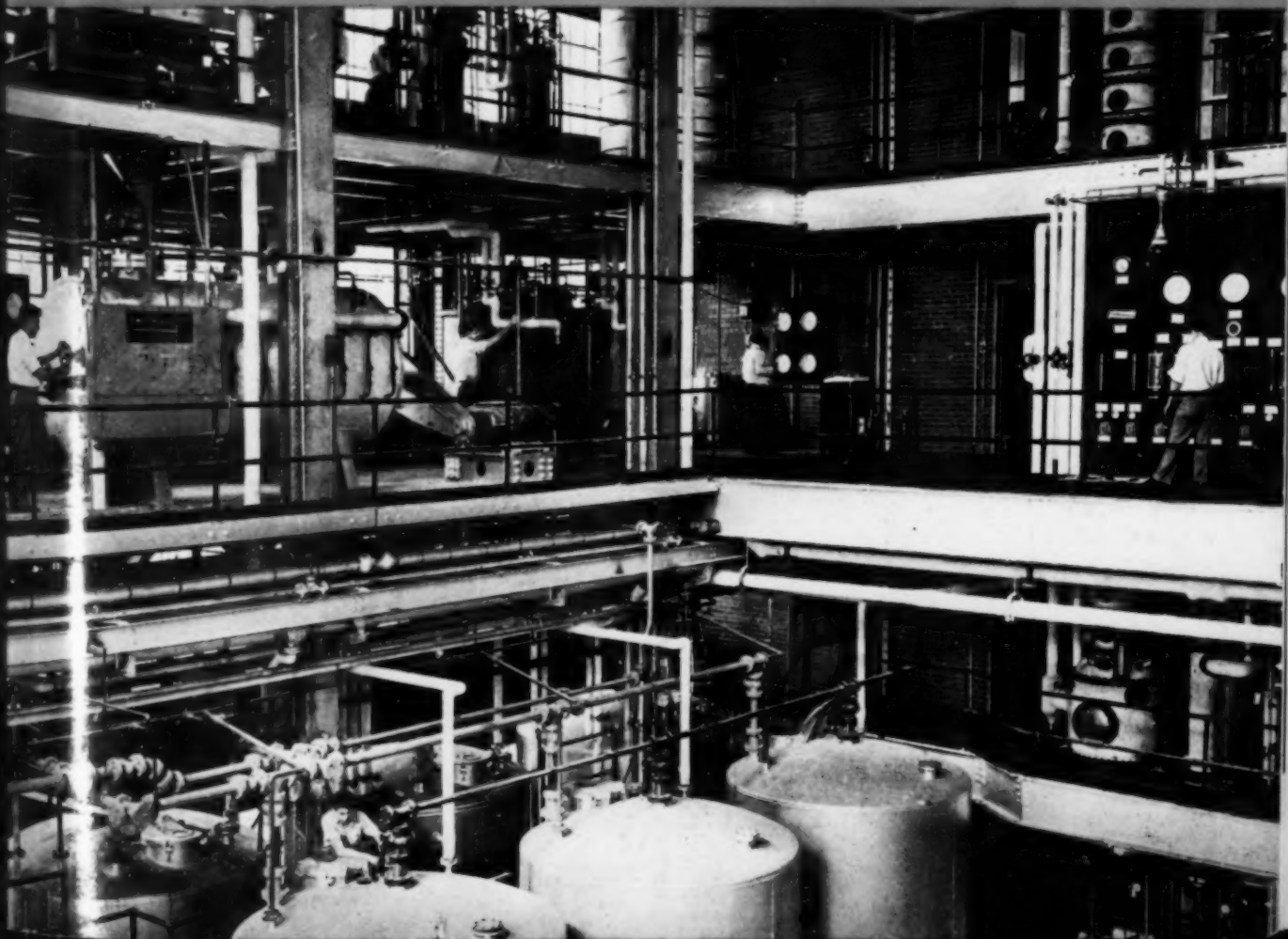


CHEMICAL & Metallurgical ENGINEERING

For OCTOBER, 1944 • CHICAGO'S THIRD NATIONAL CHEMICAL EXPOSITION FOCUSES
ATTENTION ON MIDWEST'S RAW MATERIALS AND INDUSTRIAL PROSPECTS • INVESTMENT
AND OPERATING COSTS IN SYNTHETIC RUBBER PLANTS • CHEMICAL INDUSTRY MAY BE-
COME BASIC INDUSTRY • DDT INSECTICIDE NOW MADE BY CONTINUOUS PROCESS

This pilot plant points the way toward greater use of Midwest materials



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High pressures, high velocities, high temperatures . . . stresses and strains, corrosion and erosion . . . *all* factors which tend to undermine safety in piping are resisted by *Tube-Turn seamless welding fittings*.

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**FOR HIGH-SPEED, UNIFORM HEATING
OF NON-METALLIC MATERIALS**

HERE'S a big advance in electronic heating—the new RCA 2-kw generator that automatically times the heating cycle, and automatically maintains maximum heating rate by compensating for changes in electrical properties of the heated substance as they occur.

Simple to operate! All you do to operate the RCA "2-B," once it is set up, is set the object to be heated on a plate (at top of unit), close the cover, and press the *start*-button. When the pre-set time interval expires, the power goes off and the cover pops open. It's actually "as automatic as your toaster."

Application: The RCA 2-B will deliver up to 6,800 BTU per hour. It is ideal for heating all manner of non-metallic substances—wood, plastics, rubber, chemicals, glass, ceramics—so long as composition is uniform. Where the material to be heated is in such form or so dimensioned that it does not fit the built-in applicator arrangement of the standard model 2-B, a modified type for operation with an external applicator system can be supplied.

The 2-B is ideal for heating plastic "preforms" before molding, and for quick curing of plastic-bonded wood parts. One pound of plastic material can be brought from room temperature to 275°F. in about 60 seconds.

Uniformity of Heating: This method of applying heat to non-metallic substances results in an even temperature rise all the way through the material; the center heats as quickly as the outside because the heat is "born" where it is needed. This result is achieved by passing high-frequency electricity "through" the material. The uniformity of heating makes it possible to heat at a high rate without developing "hot spots" within the material.

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WATCHING WASHINGTON

R. S. MCBRIDE, Editorial Consultant • PAUL WOOTON, Chief of McGraw-Hill Washington Bureau • MALCOLM BURTON, Washington Correspondent

Control over certain commodities to continue after V-E Day . . . Business to shape own reconversion with minimum of WPB interference . . . Regulations over pilot plant construction to be relaxed during reconversion . . . Action against producers of methanol from wood is speeded by Dept. of Justice . . . Forage crops supersede cotton as big consumer of fertilizer . . . Farmers' co-ops marketed over 600,000 tons of fertilizer last year . . . Government will step harder on private monopolies, but will itself foster international cartels . . . Ceramics industry can expect more natural gas after Jan. 1 . . . Little more alcohol for beverages in 1945

CHEMICAL CONTROLS CONTINUE

WHENEVER government men describe the readjustment period for industry after V-E Day, they enumerate certain commodities which must still be controlled. Among those always mentioned are certain chemicals, generally not specified by name. Perhaps Freon is most often mentioned as a chemical that will surely be scarce and therefore allocated. Other scarce items which will be allocated during this reconversion period are lumber, pulp and paper products, a few rare metals, and such items as are peculiarly important in manufacture for the defeat of Japan.

FREE JUDGMENT BY BUSINESS

RECONVERSION largely with free judgment by business executives is the policy unanimously adopted by the War Production Board under its new chairman, J. A. Krug. Since Nelson went to China the procedures of the Board have continued largely according to the pattern which he had been proposing, perhaps even speeding up a bit. Thus the government puts it up to business to plan to carry out a reconversion with a minimum of Washington dictation.

Two kinds of controls are contemplated for more or less extended periods. A few will deal with raw materials much in the fashion of allocation procedures of the war period. Some chemicals are included in the list, as indicated above. The other controls will have to do with a preference system so that those most urgently needing civilian goods for civilian purposes will have a little prior opportunity over "those who just want them." Thus some sort of guiding hand will be kept on the program of truck and tractor distribution, the sale of scarce devices, and products of other types where scarcity can be expected even

some months after resumed manufacture is achieved on a substantial scale.

THE DAY GERMANY FALLS

THE DAY Germany falls was chosen as the day on which to send out many war manufacturing cancellations. Warnings in advance of that date were beginning in early September for certain contractors. All contractors were urged to plan now how they would arrange their affairs should part of the cutback fall on them.

PILOT PLANTS NOW

It is anticipated that there will be no longer any difficulty under limitation orders for the procurement of materials with which to build pilot plants for postwar guidance in industry. There is perhaps one significant limitation on this encouraging news. For certain pilot plants chemical engineers need certain very scarce kinds of equipment. It will be essential to get parts of that kind through the allocation or preference programs which are planned for after V-E Day. But a permit merely to undertake construction of a pilot plant will not be needed in this reconversion period.

BETWEEN V-E AND V-J DAYS

INDUSTRY will not get the answer to the question of how much military production will be required after the fall of Germany until the Army indicates what its requirements will be. Shortly after the Army makes up its mind, WPB may be expected to give industry a very well-drawn blueprint from which to operate until the fall of Japan. Navy requirements will not be cut until the fall of Japan is in sight.

While waiting for some definite word from the Army, officials of WPB have drawn up limited plans and staked out the areas in which various divisions are to

operate. The opinion was unofficially expressed by officials of WPB that although the work on reconversion has been pushed on the advice of the Army, actually nothing can be done until the Army makes known the extent of its plans. It would seem that the Army had reversed its position on the subject of planning for reconversion but was still dragging its feet.

SLOW ITALIAN COMEBACK

THE CHEMICAL industry of Italy was very largely electro-chemical in nature, or interlocked with electrochemistry. It is expected that the comeback of this division of Italian business will be very slow indeed.

Throughout much of Europe the Nazis talked more about demolition of occupied areas than they accomplished in fact. But the demolition of Italian facilities is reliably reported to have been very extensive. The Nazis apparently took a special delight in destroying hydroelectric and electrochemical properties. If this situation proves to be as Washington now understands it, American industry need not expect renewal of Italian chemical enterprise on a large scale for a considerably longer time than is probable for other European activities.

STOP IT NOW!

CONTINUED sales practices that are called illegal and monopolistic will stop right now, if the Department of Justice is granted an injunction against producers of methanol by hardwood distillation. Request was made in the District Court of New York for such injunction to stop the defendants of this industry from "illegally fixing prices, curbing production, and eliminating competition" in the sale of methanol from wood.

The defendants in this civil proceeding are the same, plus Ford Motor Co., as the group in criminal proceedings started last April which made the same charges. The purpose of the present action is to get rid of these monopoly proceedings without waiting for a postwar criminal trial and the punishment which the Department hopes to impose.

One excerpt from correspondence between two of the defendants as published by the Department says: "You realize, of course, in this Denaturing Business we are riding on very thin ice. We are getting an absurdly high price for a product that can be duplicated synthetically, and it

VARIABLE SPEED

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tremendous advantages on many applications and you'll find it's easy to secure even greater advantages from your variable speed drives when you use Master Speedrangers.

Greater advantages because the Speedranger is a compact integral unit . . . only one unit to mount . . . saves space, saves money.

Greater advantages because Speedrangers are available for every current specification, every type enclosure, with gearheads, uni-brakes . . . and in the whole wide range of types in the Master line. This wide flexibility makes it easier to secure just the right drive for each installation.

For example, note the two Speedrangers on the machine below. One is supplied for flange mounting and the other for side wall mounting. Thus they fit neatly into the machine . . . economical to use . . . easy to apply.

And it's easy to keep right on enjoying these advantages because the all-metal construction of the Speedranger insures much longer trouble free service than units in which less durable materials are used. In addition, the complete Speedranger is designed and manufactured as a unit in one plant by one manufacturer, so there is no division of responsibility for its satisfactory operation.

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SPEEDRANGERS



is a matter of pure cooperation and some politics that we are enjoying the position of supplying these goods . . ."

STRANGE UNIT, THE "TOR"

AMERICAN engineers and physicists have lately been puzzled by a new unit appearing in the technical literature. Specialists in the Bureau of Standards explain that this unit, the Tor, is an abbreviation for the name "Torricelli." One Tor is the pressure equal to a column of 0.75009 mm. of mercury under standard conditions. It appears that this term was intended to be a simple unit equal to 1,000 dynes per sq. cm. or equal to 1,000 baryes.

This unit originated quite a number of years ago in international discussions of physicists. It has been used principally by Dutch scientists of Leyden but is only rarely used in England or the United States. Although having little usage here, it will be found in the technical literature often enough that the engineer must understand it.

HAY INSTEAD OF COTTON

COTTON used to be a major crop using fertilizer. It is still extremely important, but is a shrinking market because of a decline in demand for this textile fiber. Now National Fertilizer Association is giving greater emphasis to the use of its products on pastures and for hay crops. There seems to be an insatiable demand for milk and milk products. This is likely to increase the need for efficient pasture and hay development. Chemical industries interested in fertilizers will watch this trend as it is an ultimate market of importance. Furthermore, agronomists state that the kinds of fertilizer needed in many areas may be quite different when forage is the objective instead of fiber.

CO-OPS, GOOD CUSTOMERS

MARKETING fertilizers by cooperative associations of farmers has been steadily increasing for many years. Farm Credit Administration data are quoted by National Fertilizer Association to show the very great importance of this even in wartime. It is reported that 17 major co-op associations last year sold \$19,871,000 worth of fertilizer. That must have been at least 600,000 tons at a typical price. Washington is encouraging this trend, which means that chemical producers supplying raw materials must consider the farm associations as outstanding among those who need education about chemical raw materials for the farm.

POTASH PROGRAM: A FLOP

FROM all appearances, the government's potash program has flopped. The Department of Interior has not told exactly what happened to cause them to give up their idea of going into the business of produc-

ing potash for fertilizer. The top officials reluctantly concluded that the government could not compete with private industry in this field when the drilling program failed to locate the raw material.

NEW CARTELS

REGARDLESS of the administration in power next year it is expected that there will be numerous international organizations established which are in effect little different than the prewar cartels. The wheat program must be continued for stabilization of that surplus grain in world markets. The petroleum agreement with Great Britain represents another sort of plan "necessary for the protection of America." It is stated to be a plan to protect against scarcity; but actually one of its most immediate effects in industry will be to prevent gross waste which so readily comes from temporary or local surpluses of crude oil.

A dozen other commodities are likely to be subject to discussion on an international basis and may be governed in the near future by comparable agreements. Any type of goods that is important in international trade affecting the United States is expected to be so considered if not actually regulated, almost regardless of the political or economic leanings of the administration in power. Congress is largely ignored in these negotiations until commitments are made which are very difficult if not impossible to modify by legislation.

CARTELS, GOOD AND BAD

WASHINGTON simultaneously presses two conflicting policies regarding cartels. It undertakes to attack private cartels without distinction and it proceeds to organize governmental cartels where they serve the official convenience.

This conflict in policies is frequently criticized, but no change is expected. The Anti-Trust Division of the Department of Justice will unquestionably continue in the next year much more aggressive anti-monopoly proceedings, unless there is a change in top administration policy. The present staff in Justice believes that they have in this anti-cartel campaign the best basis for securing continuance or even expansion of the authority and funds for their work. Thus, the word "cartel" is going to be used freely, even promiscuously.

DDT IS TOXIC

OFFICIAL Washington has not yet made up its mind as to the meaning of new very specific conclusions regarding the toxicity of DDT to both animals and humans. The toxicological studies of the Food and Drug Administration recently released indicate that very severe limitations are likely to be placed by various government agencies on the postwar applications of this important insecticide. The

government agencies are continuing their investigations in the hope that they may define proper methods of application which will not unduly interfere with the use of this new chemical which has had such wide acceptance during the war period for relieving otherwise difficult conditions in the field, especially abroad. Frank criticism based on toxicity does not indicate any desire of the government officials who made the report to place even a single unnecessary restraint.

POST-WAR ALUMINUM

NUMEROUS estimates of the requirements for light metals after the war have been surveyed by government specialists. One of the most significant results has been a recent summary published by Walter A. Janssen, metals specialist of the Bureau of Foreign and Domestic Commerce. This observer points out that "among all estimates expressed, the figure 900,000,000 pounds is heard most often." Thus, the Department of Commerce apparently accepts that guess as to annual postwar aluminum consumption as one from which to proceed in its other postwar forecasting.

The breakdown of major uses by industry of aluminum in early postwar years is then calculated as follows: Transportation 34 percent, machinery and electrical appliances 12, cooking utensils 10, building construction 9, electrical conductors 8, chemical 5, foundry and metal-working 5, food and beverages 5, ferrous and non-ferrous metallurgy 4, and miscellaneous 4.

SULPHURIC ACID SHORTAGE

ASIDE from the few places where a spot shortage of sulphuric acid may occur the Louisiana-Texas-Oklahoma area is the only place where a shortage is a more or less chronic condition. Requirements on the West Coast are being met since additional capacity was made available in that area. No new capacity will be provided in the mid-South, according to present official thinking.

If the high octane gasoline and explosive programs require more acid than they have been getting, the shortage will be satisfied by taking it from the fertilizer industry.

FARM WASTE STUDIES

PART of the synthetic liquid fuel program of the government is to be the manufacture of liquid fuels from agricultural and forestry wastes. That project is under the direction of E. C. Lathrop at the Peoria Regional Laboratory of the Bureau of Agricultural and Industrial Chemistry. This will not be a further expansion of the routine studies for the manufacture of alcohol from cellulose. Quite a different program is planned.

This Laboratory has done important preliminary work on processing of these



1. Remove Rust, Scale, Old Paint, Grease and Dirt.



2. Apply Tygon Primer by spray gun or brush.



3. Apply One or More Tygon Topcoats—depending upon the anticipated severity of attack.

3 Simple Steps TO ACHIEVE CORROSIVE PROTECTION

● TYGON Paint is an effective safeguard for metal, concrete or wood surfaces against corrosive attack by acid or alkali fumes, condensates or spillage, or for surfaces exposed to oil, gasoline, alcohols, moisture, salt air or other tough weather conditions.

Tygon Paint is not an ordinary paint. It is pure Tygon—the chemically inert, rubber-like plastic used to line acid tanks—liquefied by the addition of proper solvents. On evaporation of the solvents a tough, sturdy, durable film of pure Tygon remains. Unlike ordinary paints Tygon is not subject to oxidation and does not chemically deteriorate with age.

Tygon Paint is easily applied by spray gun or brush. Surfaces should be clean, free from old paint, rust, grease or dirt. One coat of rust-inhibiting Tygon primer is applied, followed by one or more Tygon topcoats. Tygon Paint air dries quickly to a lustrous, easily cleaned surface that resists accumulations of greasy scum or dirt.

Make your own tests: On request we will be glad to send you a test sample of Tygon Paint so you may determine its effectiveness in your own plant.

- Resistant to most acids, alkalis, and alcohols
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- May be air-dried or baked
- Available in white, black, clear, gray, green, red, blue, aluminum

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agricultural wastes during the last year or two. The new funds (over \$400,000) will permit the building and operation of a small pilot plant to test the economic significance of these methods. Intermediate products will include both lignin and fermentable sugars. Some attention will also be given to the pentoses and means for their utilization. The broad objective of new liquid fuels will be directly served; but an important amount of byproduct information is expected which will have a bearing also on cellulose from either farm or forest as a raw material for many other chemicals.

MORE GAS FOR CERAMICS

SHORTAGE of natural gas for fuel in China and other ceramic industries of the Appalachian region has been a serious problem in recent years. Those industries are, therefore, receiving with enthusiasm the Washington forecast that more natural gas will be available this year than last. WPB says of this situation: "Construction of the Texas gas pipeline is progressing satisfactorily and it is expected to be ready for use around Jan. 1, 1945. When completed, it will carry about 200 million cu. ft. of gas a day into the Appalachian area. The gas storage program is also being carried out successfully. It was estimated that about 29 billion cu. ft. of gas would be available in underground storage by winter, about two billion cu. ft. more than was available last winter." Despite these new supplies the ceramic industry may occasionally have to close down on gas usage briefly at periods of peak demand for home-heating or war-industry use.

ALCOHOL TO NEED RULES

THE ALCOHOL program for 1945 is already broadly determined. No speed-up or war success can possibly permit extensive natural rubber delivery to the United States next year. This means that for most of the year synthetic rubber from alcohol will remain the backbone of our rubber program. The first important shift from that plan is expected only when large increase can be arranged for butadiene supply from petroleum.

Some relief from restrictions from alcohol usage will probably be made during the winter. Also the hope is held out to the beverage industries that they may have another holiday from industrial alcohol manufacture in the not too distant future. This hope is, however, conditioned partly on the assumption that the bottleneck in the rubber program will remain in labor supply at the tire factories. Should a large number of workers suddenly become available for tire making, there may be increased demands for buna rubber which will somewhat delay relief of pressure on the alcohol program.

It is definitely forecast by officials that both sugar and molasses will be very

scarce next year. This means that more alcohol must be made from grain, which is expected to be abundant. Already restrictions on use of grain sorghum have been removed; and plenty of corn and wheat seem assured.

PRICING AND RE-EMPLOYMENT

PRICING of civilian items on which production will begin after Germany collapses may be the key to the rapid re-employment of labor released from war industries. Official estimates put the number to be laid off within 24 to 36 hr. after the fall of Germany at from one to three million. War production is scheduled as if the European phase would not end until late 1945. Hence the abrupt slash. It is estimated that more than nine million will be affected, some by actual separation from industry and others by the abandonment of overtime pay.

Planners close to the White House are endeavoring to find a formula by which prices of civilian items will be kept low enough to be within the reach of labor. Since the purchase of durable goods such as refrigerators and automobiles is from income rather than savings, the psychological problem is to establish prices which people with reduced incomes will find within reach. Without this buying to stimulate the civilian industry, reconversion and re-employment will be slow and may bring on a declining spiral of industrial activity.

OPA economists expect to handle big manufacturers on a direct negotiation basis with a formula for the smaller producers. No announcement may be expected from OPA until the last possible moment. All moves will be toward a high wage, high production, low cost economy.

SYNTHETIC LIQUID FUEL

INVESTIGATIONS which will lead to the final selection of sites for the location of laboratories and pilot plants to carry out the Bureau of Mines' synthetic liquid fuel program are now underway. The Bureau is sending engineers to report on all sites with promise. In September, field parties were in Wyoming examining proposed sites for pilot plants for the liquefaction of coal or lignite. The investigation will cover not only Wyoming, but also the states of Utah, Colorado, the Dakotas and eastern Montana.

Two demonstration plants are being planned, one to be located in the East and the other in the West. Each plant will be able to handle synthesis gases from either coal or agricultural and forest products. A third demonstration plant is contemplated for oil shale. Experimental laboratories and small pilot plants will be needed for each of the three methods.

More information on this program on the synthesis of liquid fuels appears on p. 84 of the May, 1944, *Chem. & Met.*

SURPLUS PROPERTY ACT

ONE OF THE serious defects in the Surplus Property Act of 1944 is the provision that any of a dozen types of plants costing more than \$5,000,000 can not be sold without the consent of Congress. That is expected to be a great handicap in the disposal of some of the special facilities which cannot be sold for as much as a tenth of their original cost. Even before the bill had received the President's signature a number of larger concerns who would naturally compose the market for the big government plants expressed their reluctance to submit themselves to the Congressional inquisition that would be required before the purchase could be ratified.

TYPES OF FACILITIES

THE SURPLUS Property Act lists 12 types of facilities concerning which a report must be submitted to Congress within three months after enactment. Included in the report must be a description of the property, cost and locality, outline of the economic problems that may be created by the disposal of the property and a plan for "the care and handling, disposition and use of the property consistent with the policies and objectives set forth in this act." The facilities listed are as follows:

"(1) Aluminum plants and facilities; (2) magnesium plants and facilities; (3) synthetic rubber plants and facilities; (4) chemical plants and facilities; (5) aviation gasoline plants and facilities; (6) iron and steel plants and facilities; (7) pipe lines and facilities used for transporting oil; (8) patents, processes, techniques, and inventions, except such as are necessary to the operation of the plants and facilities herein listed; (9) aircraft plants and facilities and aircraft and aircraft parts; (10) shipyards and facilities; (11) transportation facilities; and (12) radio and electrical equipment."

PLANT CONTRACT OPTIONS

INDUSTRIES which have been building or operating plants for the government under contracts that included options to buy will presumably still have that privilege despite the new surplus property disposal act. Such companies have a legal and binding arrangement with the government. That arrangement would prevent such property from becoming "surplus" until all of the provisions of the lease arrangement have been satisfied.

This is an extremely important probable (almost certain) interpretation of the new law. It means that chemical process industries will not have to wait many months for Congress to say whether such plants can be "sold" if they decide to take them over under their lease option arrangements. Such taking over will not be a "sale," according to the best Washington guesses early in October.

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COLUMBIA SPOTLIGHT



HEXACHLORETHANE is one of the smoke-producing chemicals which our Chemical Warfare Service has used to such great advantage on every front. Screening our operations from observation has reduced enemy effectiveness and kept down our casualties. As indicated by the name, chlorine is one of the ingredients of hexachlorethane, and Columbia is one of the principal producers of chlorine required for this purpose.



ALLYMER—Columbia's recently announced thermosetting plastic—is truly a "contact-pressure" resin. In making laminated products, only enough pressure is used to keep plies in contact with the mold. The relative simplicity of the tooling necessary when Allymer is used and the large complicated sections which can be made greatly extend the application possibilities for laminated parts. Research reports and other data are available on request.



HOMEMAKERS, who have despaired of the ugly black marks left on floors by rubber-shod members of their families, can now eliminate this nuisance by insisting that "no-mark" soles and heels be obtained. Those two remarkable Columbia pigments, Calcene T and Silene EF, are being used with GR-8 to make a highly satisfactory no-mark sole and heel stock. Primarily developed for the rubber industry, new uses for these pigments are being uncovered in numerous other fields. Write for information.



THOUGH THOUSANDS think of "bicarb" only for the relief it brings to certain stomach maladies, Sodium Bicarbonate serves in scores of other important uses in a variety of industries. To name but a few—in the baking and milling field, particularly as an ingredient of baking powders and self-rising flours... in the leather industry, as a neutralizer in tanning operations... in textile manufacturing, for the prevention of timber mold. Columbia manufactures three grades of Sodium Bicarbonate in various granulations to meet the specific needs of customers in every field.



COLUMBIA CHEMICALS include Soda Ash, Caustic Soda, Sodium Bicarbonate, Liquid Chlorine, Silene EF (Hydrated Calcium Silicate) Calcium Chloride, Soda Briquettes, Modified Sodas, Caustic Ash, Phosflake, Calcene T (Precipitated Calcium Carbonate) and Calcium Hypochlorite.

When Timing is of the Essence

Soon the great bombers will take off on another history-making raid. The briefing session has charted the mission in minute detail—each crew knows its exact task. Eyes on watch, an officer calls out, "In 15 seconds it will be 4:08... 10 seconds... 5, 4, 3, 2, 1, check—4:08."

The success of a large-scale aerial attack depends on a multiplicity of supporting factors, including supplies, data on the target area, weather, flight courses, altitude and approach of the bombing run. And timing.

Similarly, the timing of production schedules is all-important in successful manufacturing operations. When raw materials meet specifications one source of costly delays is avoided. Columbia's reliability in this respect helps maintain production... an important reason why Columbia is the preferred supplier for so many manufacturers.

COLUMBIA CHEMICALS



**PITTSBURGH PLATE GLASS COMPANY
COLUMBIA CHEMICAL DIVISION**

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CHEMICAL & METALLURGICAL ENGINEERING • OCTOBER 1944 •

INTERPRETATIONS

This installation covers orders, rules and regulations issued by the War Production Board and the Office of Price Administration during September, 1944. Copies of each item interpreted here may be obtained from the appropriate federal agency.

SYNTHETIC ORGANIC SOAPS

ALLOCATION control has been placed on distribution of synthetic organic soaps. This control applies only to supplies for the military services and industry will continue to receive allotments in accordance with the established preference rating procedure now in effect. These soaps have specialized military uses such as germicidal rinses, softening of salt water and for mobile laundries in combat areas. Priority ratings will be granted to industry for use in production of rubber, textiles, dyestuffs, leather, metal, pulp and paper, insecticides, germicides and dairy cleaners and for special industrial purposes. About 25 percent of the output will be available for industry.

AVIATION GASOLINE

DISTRIBUTION of 73 and 80-octane gasoline to private planes has passed from the control of OPA to the Civil Aeronautics Administration. Distribution will follow the plan employed by the Petroleum Administration for War on higher octane aviation gasoline, which does not involve coupon rationing. Allotments will be made to airports and will be distributed by the operators in accordance with standards established by CAA, in conservative quantities sufficient to permit civilian airports to remain in operation for specified purposes.

INSECTICIDE MATERIALS

PREVIOUS orders governing arsenic, rotenone, pyrethrum and copper chemicals have been revoked and these products are now under the regulations as set forth in Order M-300. The transfer has made no difference in the allocation procedure for arsenic and copper chemicals. All production involving the use of rotenone must now receive WPB authorization. Prior to the current amended order, persons were permitted to manufacture or process insecticides containing a maximum of one-half of one percent of rotenone without specific permission.

BISMUTH CHEMICALS

ADEQUATE supplies of bismuth chemicals will be available to meet all civilian requirements for medicinals for the fourth quarter of this year according to a WPB announcement. While the supply apparently will be large enough to take care of

requirements, it is not expected that allocation controls will be lifted in the near future as a change in military needs might alter the supply situation.

BENZENE AND TOLUENE

CIVILIAN allotments of benzene, toluene and xylene have been drastically cut as a result of increased military requirements for use of these chemicals in aviation gasoline and TNT. The situation is expected to remain tight until next April. Benzene is used to raise the octane rating of aviation gasoline but small amounts will be available for lacquer thinners and aniline dyes. While expanded ordnance requirements for toluene in the production of TNT have brought corresponding cuts in civilian allotments it is stated that WPB may reduce the amounts available for gasoline so as to favor the production of explosives. The increase in use of xylene in aviation gasoline has cut down its use in protective coatings but also has spurred efforts to increase production and WPB is taking steps to enlarge the output of xylene from petroleum.

GLASS CONTAINERS

THE GLASS container quota order has been amended because supplies have been quite large for some months. Chemicals have been added to the unlimited use while quotas for all other products have been increased by approximately 30 percent. More freedom in the use of glass containers is given to the small packer with the exemption figure doubled from that previously in effect.

REFRIGERANT CHEMICALS

CONTINUED use of substitute refrigerants such as methyl chloride, sulphur dioxide and ammonia, has been ordered by WPB to take the place of freon-12 as the latter is in limited supply. Earlier in the month the industry committee had discussed the problem of supplies and it was reported that of the 1,060 tons of hydrofluoric acid promised producers of freon for October, only 685 tons will be available at that time. Acid plants are producing only about 75 percent of their overall expected capacity because manufacturers overestimated their production capacity and because two new plants failed to begin operations on scheduled time. Plans for increasing acid capacities by 10 percent are under consideration.

SILICA GEL

DEMAND for silica gel for moisture-proof packaging of military materials has increased to a point where this material has been placed under the control of Order M-300. Catalyst grade and desiccant grades that are finer than 80 mesh have not been placed under allocation. The

catalyst grade is used in the petroleum industry and the fine desiccant grades are used in industrial gas masks and for cable splicing.

DYESTUFFS AND PIGMENTS

RESTRICTIONS pertaining to use of dyestuffs and organic pigments exported from the United States to Canada have been modified in an amendment to Conservation Order M-103. The amendment merely eliminates restrictions on the use of dyestuffs by Canadian consumers. It does not affect distribution of dyestuffs to Canada or the distribution or consumer use of dyestuffs within the United States which still remains under control.

PRICE REGULATIONS

DICHLOR-DIPHENYL-TRICHLOROETHANE (DDT) has been exempted from price control. This action was taken because the constant change in specifications used in preparing this insecticide precludes any immediate and accurate determination of prices. When its final processing specifications are determined an order will be issued controlling the price.

Maximum prices for reclaimed rubber were raised one-quarter cent a lb. on Sept. 9 to help compensate manufacturers for increases in scrap rubber, labor, and other costs that have occurred since Dec. 1941 when the earlier ceilings were established. Ceiling prices vary as they are the highest prices charged by each seller during the base period, Nov. 5, 1941 to Dec. 5, 1941.

Permanent maximum prices went into effect Sept. 20 for gum resin. The maximums are at levels based on average prices in June and July of this year on the Savannah Cotton and Naval Stores Exchange. The prices range from \$4.81 for B to \$6.32 for WW and X, the figures being per 100 lb., net, in drums.

A price of \$4.50 per unit of ammonia has been set for castor pomace in bags, fob point of production west of the 100th meridian which runs through North Dakota, South Dakota, Nebraska, and Texas. This action reflects the higher transportation costs on castor beans shipped from New Orleans to the west coast. The price of \$2.90 per unit of ammonia for pomace produced east of the 100th meridian remains unchanged as does the maximum of \$15.50 per ton for unground castor cake.

Higher prices were authorized in an order, effective Sept. 21, which sets a maximum for ester gum with a resin content consisting wholly of gum resin and wood resin, the maximum is equal to the weighted average of \$0.1125 and \$0.095, weighted according to the percentages by weight of the two types of resin.

Due to higher primary costs, ceilings for wattle bark and extract were raised \$3 a ton for bark and 25-45 c. per 100 lb. for extract.

FROM MINE, FARM AND FOREST

—Tomorrow's Industries



Where do we go from here? What have we learned in these four hard years of war production? What have we got in the way of new technology, plants, resources that will help us in the job ahead? Glorious victories in Europe and the Pacific are bringing new challenges to the chemical industry and profession. It is time we re-appraise our resources in preparation for both reconversion and reconstruction.

Fortunately the Third National Chemical Exposition in Chicago next month comes at a time when it can help most in preparing for the future. Part of that preparation must begin in our own minds as we think through with the plans and problems we face as chemists and chemical engineers. Part has to do with our plants and processes that must be put back into peacetime production. Part is the bigger policy-making job for chemical industry as a whole and the role it is to play in both regional and national economy.

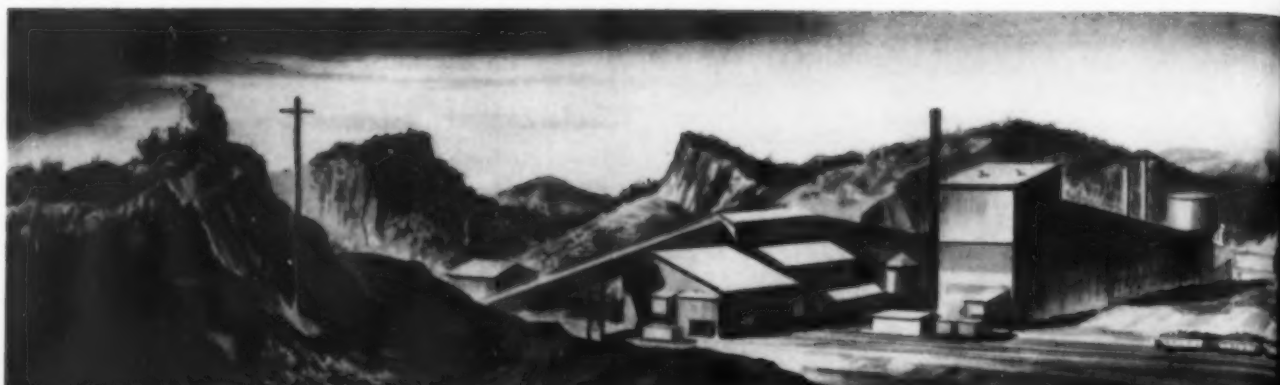
In this period of introspection and self-appraisal we must get down to the fundamentals on which our industries are based. Most elemental of these are the raw materials that, together with other economic and technical considerations, determine plant location and scale of operations. In chemical industries that famous trinity of sources — mine, farm and forest — immediately suggest a study of our vast mid-western empire, particularly those fourteen states that lie west of the Alleghenies, east of the Rockies and north of Tennessee. In them is to be found more than half of the nation's war production. Their plants formerly accounted for a third of the output of the process industries. Somewhere between the two is the goal toward which this area is reaching in its plans for reconstruction.

This Chemical Exposition issue of *Chem. & Met.* has been planned to help in this review of fundamentals. A series of charts picture the broader outlines of our de-

pendence upon the products of mine, farm and forest. Then follow four unique articles. In the first of these George E. P. Smith, Jr. and Henry F. Palmer of the Firestone Tire and Rubber Co. show the broad relations of chemical industry to seven basic raw materials. Later in this issue they discuss the factors affecting the further growth and development of this important field. Our second article is from Orville E. May, the young and brilliant successor in the eminent position in the Department of Agriculture once held by Drs. Wiley, Alsberg, Browne, Knight and Skinner. Dr. May's close association with agricultural research following his success in organizing and directing the Regional Research Laboratory at Peoria, well qualifies him to appraise and interpret scientific and technological developments in the utilization of farm products. Third in the series is the contribution of John A. Hall of the U. S. Forest Service. In this war no American chemist or engineer has worked harder or more effectively in calling attention to wood as a chemical raw material. Largely through his personal efforts came the OPRD program of pilot-plant and large-scale development of wood hydrolysis as an "insurance" source of ethyl alcohol. His great concern now is for an integrated chemical engineering industry based on the abundant wastes of the forest.

Finally, Paul D. V. Manning, vice-president in charge of research for International Minerals & Chemical Corporation shows the intimate inter-relationships of the mineral and chemical industries, with particular reference to the Middle West. This, in a sense, helps to round out a refresher course in chemical engineering economics preparatory to your personal participation in the exposition and meetings in the Chicago Coliseum, Nov. 15 to 19. If you can spare the time from war work, be there and contribute your share in helping to build tomorrow's industries.





POTASH

FERTILIZERS
BAKING
GLASS
SOAP
MEDICINE
METALS
DYES
EXPLOSIVES
PRINTING

PHOSPHATE ROCK

SUPERPHOSPHATE FERTILIZERS
PHOSPHORIC ACID
FERRO PHOSPHORUS
FLUOSILICIC ACID
ELEMENTAL PHOSPHORUS
PHOSPHATES OF
Ca, Na, NH₃, K. etc.

FLUORSPAR

STEEL INDUSTRY

GLASS & ENAMEL

HYDROFLUORIC ACID

ARTIFICIAL CRYOLITE
ALUMINUM FLUORIDE
REFRIGERATORY MEDIUMS

LIMESTONE

CRUSHED LIMESTONE

METALLURGICAL FLUX
SULPHITE PULP
SUGAR
FERTILIZER

LIME

CO₂ & DRY ICE
CALCIUM CARBIDE
GLASS MAKING
SILICA-BRICK MAKING
INSECTICIDES, FUNGICIDES,
DISINFECTANTS
SODA PULP
SULPHATE PULP
PAPER FILLER (WHITING)
LEATHER TANNING
METALLURGY
CAUSTIC SODA
SUGAR REFINING
BLEACHING
ACETATE OF LIME
MAGNESIA PRECIPITATION
WATER PURIFICATION
WATER SOFTENING
CYANAMIDE
PAINTS
PETROLEUM REFINING

CEMENT

PORTLAND CEMENT
LOW HEAT CEMENT
CORROSION-RESISTANT
CEMENT

FROM AMERICAN MINES

These

Chemical Process Industries

Raw Materials	1943 Domestic Production	Estimated Percentage Used in Process Industries
POTASH	1,428,840 tons	88
PHOSPHATE ROCK	5,369,967 long tons	90
FLUORSPAR	406,016 tons	36
BARITE	429,298 tons	67
SALT	15,214,152 tons	76
COAL	589,000,000 tons	16
PETROLEUM	1,503,000,000 bbl.	95
SULPHUR	2,538,786 long tons	78
LIME	6,596,615 tons	37



BARITE

BARIUM CHEMICALS

BLANC FIXE
(pptd. BaSO_4)
BARIUM CARBONATE
BARIUM CHLORIDE
BARIUM DIOXIDE
BARIUM SULPHIDE

LITHOPONE

PAINTS
ENAMELS
LACQUERS
FLOOR COVERINGS
TEXTILES

GROUND BARITE

GLASS MAKING
PAINTS

SALT

AMMONIA-SODA

GLASS
CHLORINE
BLEACHES
CHLORATES
HIGH OCTANE GASOLINE
SMOKELESS POWDER
EXPLOSIVES
ANTIFREEZE AGENTS
WATER PURIFICATION
TEXTILE PROCESSING
DYES
ORGANIC CHEMICALS
FOOD PROCESSING

COAL

GAS

NITROMETHANE
METHYL CHLORIDE
METHYLENE CHLORIDE
CHLOROFORM
CARBON TETRACHLORIDE
PLASTICS
PLASTICIZERS
SYNTHETIC RUBBER
WETTING AGENTS
RUBBER CHEMICALS
EXPLOSIVES
NITROETHANE
SOLVENTS
COOLING LIQUID
ANTIFREEZE
POLISHES, WAXES
ETHYLAMINE
TETRAETHYL LEAD
AIR DISINFECTANT
HIGH OCTANE GASOLINE
GLYCERIN
ISOPROPYLAMINE
BUTYLAMINES

COKE

EXPLOSIVES
PLASTICS
FORMIC ACID
SYNTHETIC
EDIBLE OILS
GASOLINE
LUBRICATING OIL
SOAP
SYNTHETIC RUBBER
PLASTICIZERS
RUBBER ACCELERATORS
WETTING AGENTS
ADHESIVES
ACETIC ACID
CARBON TETRACHLORIDE,

PET. & NAT. GAS

GASOLINE

CHLOROPENTENES
AMYL MERCAPTAN
RESINS
AMYLAMINES
SOLVENTS
PLASTICIZERS
AMYL ACETATE
SYNTHETIC RUBBER
PLASTICS
DYES
RUBBER ACCELERATORS
SULFANILAMIDE
PHARMACEUTICALS
BENZENE
SULPHONIC ACID
WETTING AGENTS
NITRODIPHENYLS
RUBBER ANTIOXIDANTS
EXPLOSIVES (TNT)
SACCHARIN

KEROSENE

LUBRICATING OILS

COAL OIL & COAL TAR

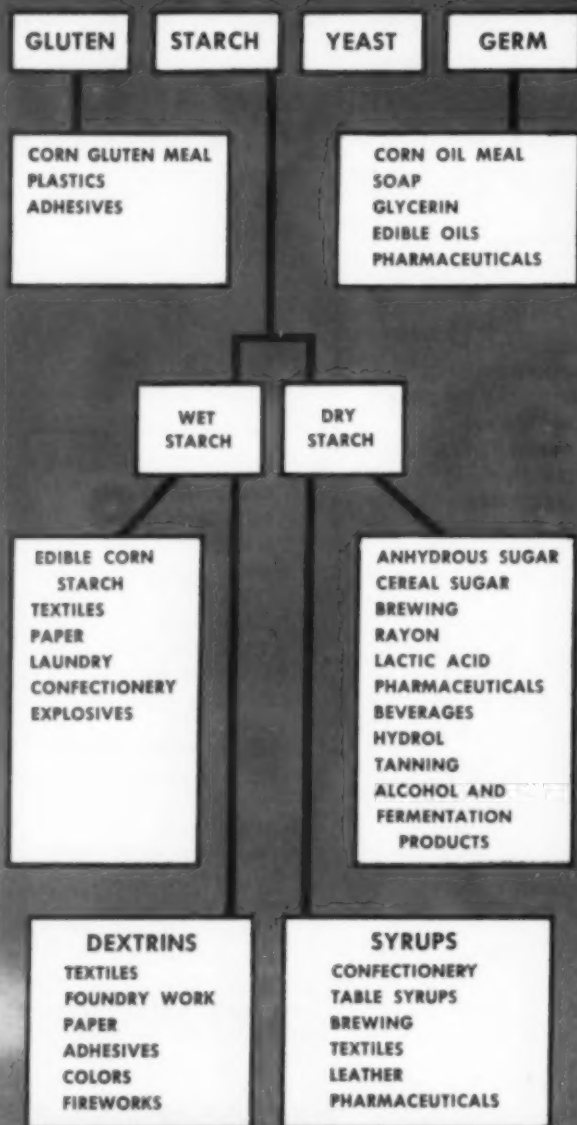
PIPERIDINE	NITRODIPHENYLS
RUBBER ACCELERATORS	RUBBER ANTIOXIDANTS
SYNTHETIC RUBBERS	EXPLOSIVES (TNT)
PLASTICS	RESINS
MOTH PREVENTIVE	SACCHARIN
DYES	PICRIC ACID
SULFANILAMIDE	NYLON
PHARMACEUTICALS	ANTISEPTICS
BENZENE	GERMICIDES
SULPHONIC ACID	ADHESIVES
WETTING AGENTS	SALICYLIC ACID
PLASTICIZERS	

AMMONIA

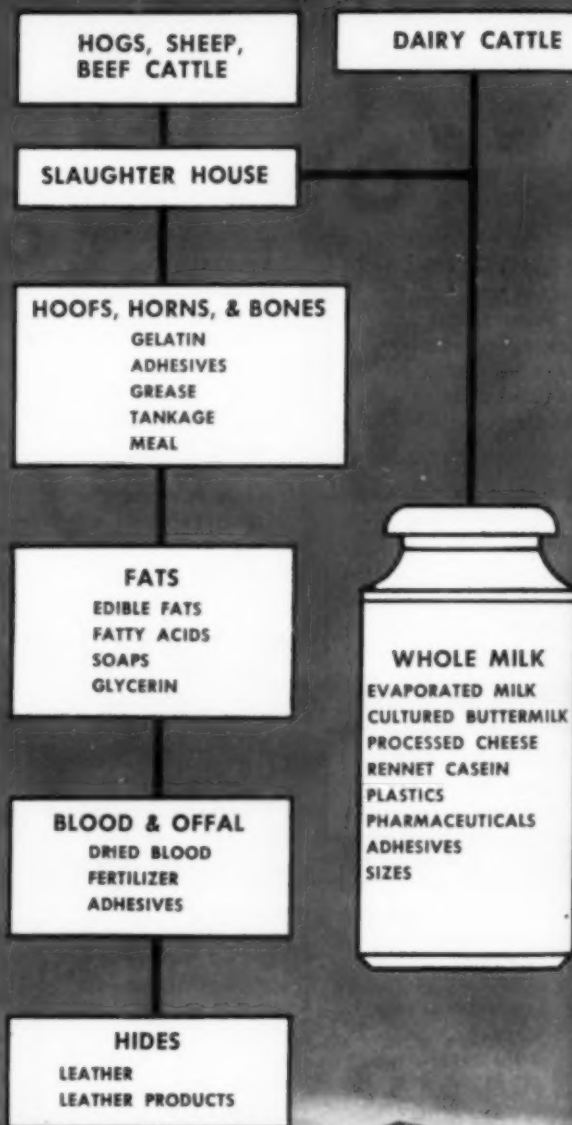
DYES FERTILIZERS
EXPLOSIVES

FROM AMERICAN FARMS

CORN



ANIMAL PRODUCTS



These Chemurgical Products

CEREAL-GRAINS

FERMENTATION & DISTIL. PLANTS

CO₂, DRY ICE
ACETONE
LACTIC ACID
RUSSEL OIL
ALCOHOL
YEAST
BUTYLENE GLYCOL
GLYCERIN
CITRIC ACID

STARCH PLANTS

GLUTEN
MONO-SODIUM
GLUTAMATE
STARCH
GLUCOSE
SYRUPS
FURFURAL

BREWERY

BEVERAGES
CO₂, DRY ICE

SOY BEAN

PLANT

FURFURAL

MEAL

GLUE
CELLULOID
SUBSTITUTES
FERTILIZER
PLASTICS
WATER PAINTS
FOUNDRI
CORE BINDER

DRIED BEAN

PAINTS
PAPER SIZE
TEXTILE DRESSING
WATERPROOFING
RUBBER

BEAN

OIL

FOUNDRI CORE OIL
LUBRICANT
PAINT, VARNISH,
ENAMEL &
LACQUER
SOAP
GLYCERIN
WATERPROOFING
INSECTICIDE VEHICLE
RUBBER SUBSTITUTES
LIGHTING
FOOD PRODUCTS
HYDROGENATED OIL

COTTON

LINTERS

CHEMICAL CELLULOSE

RAYON
PAPER
EXPLOSIVES
LACQUERS & DOPES
PLASTICS
PHOTOGRAPHIC FILM
TRANSPARENT
WRAPPING MATERIAL
CELLULOSE-COATED
FIBERS
HYDROGENATED OILS
SOAPS
GLYCERIN
PLASTICS

SEED

OIL MILL

OIL

CAKE

HYDROGENATED OILS
SOAPS
GLYCERIN
PLASTICS

Farm Products

1943 Production

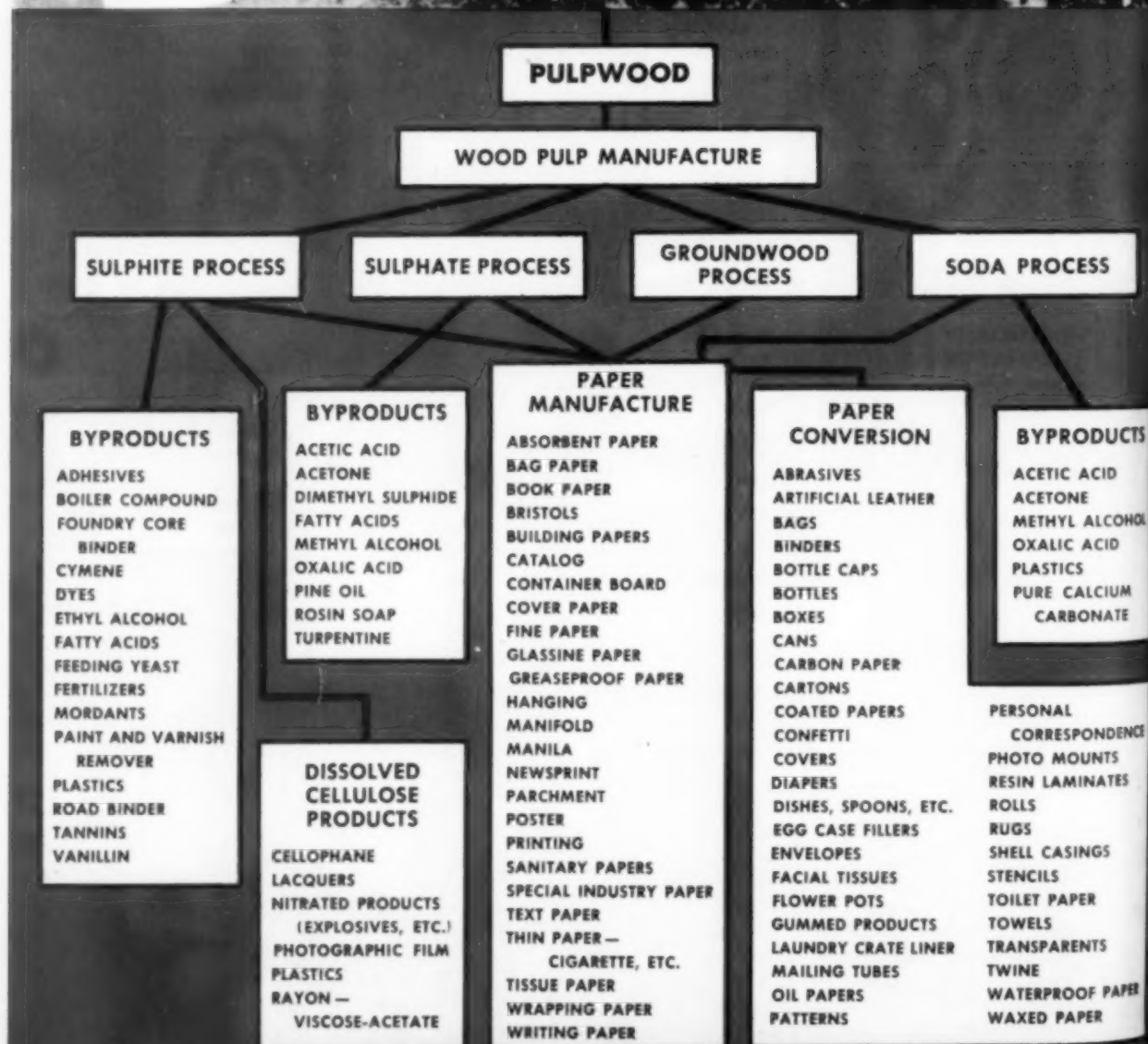
Estimated Percentage Used in Process Industries

CORN	3,076,159,000 bu.	12
WHEAT	836,298,000 "	5
RYE	57,673,000 "	10
BARLEY	322,187,000 "	20
FLAXSEED	52,008,000 "	95
RICE	70,025,000 "	3
SORGHUMS	103,168,000 "	5
SOYBEANS	195,762,000 "	90
COTTON LINTERS	1,168,000 bales	90
COTTONSEED	5,390,000 tons	80



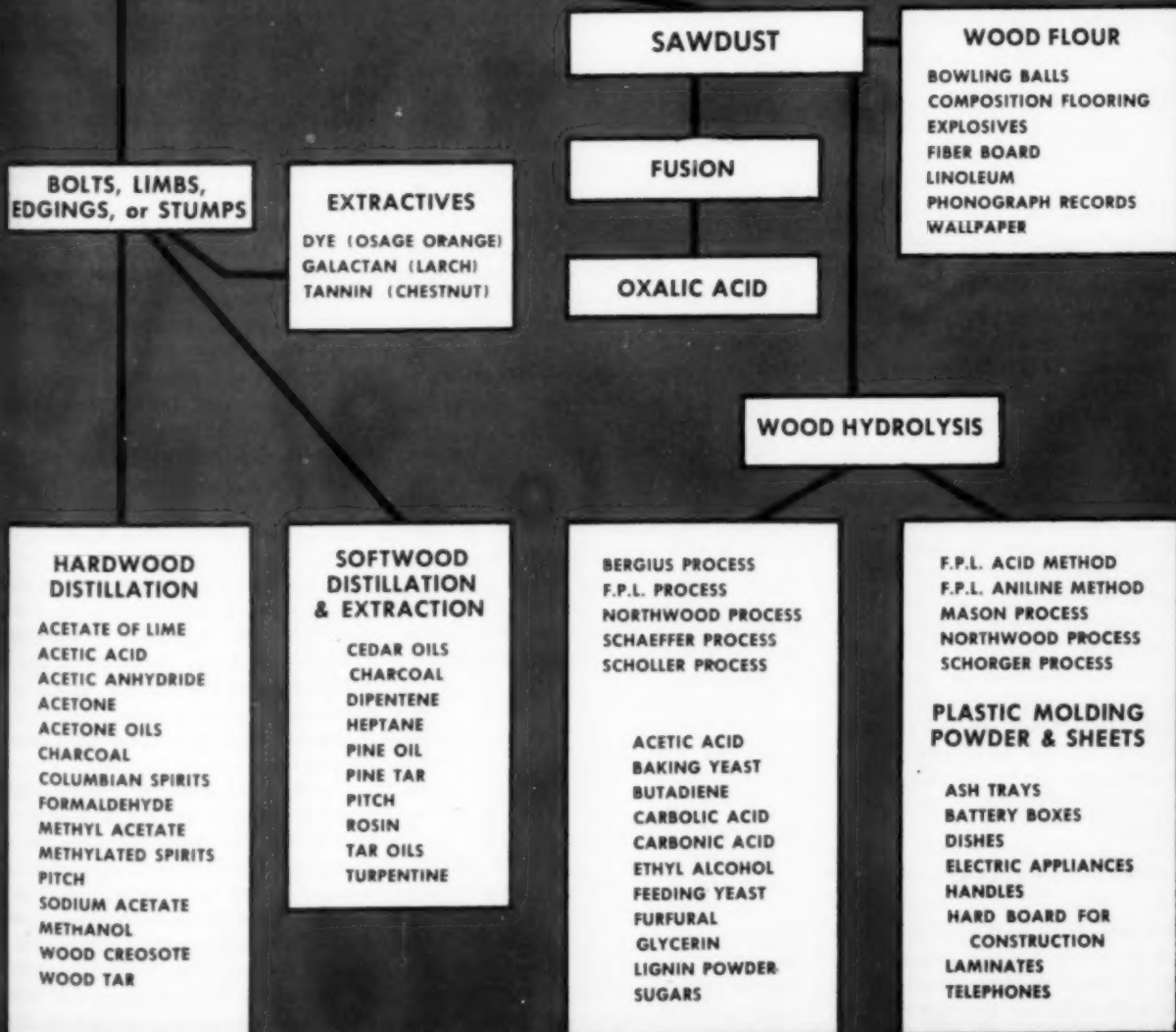
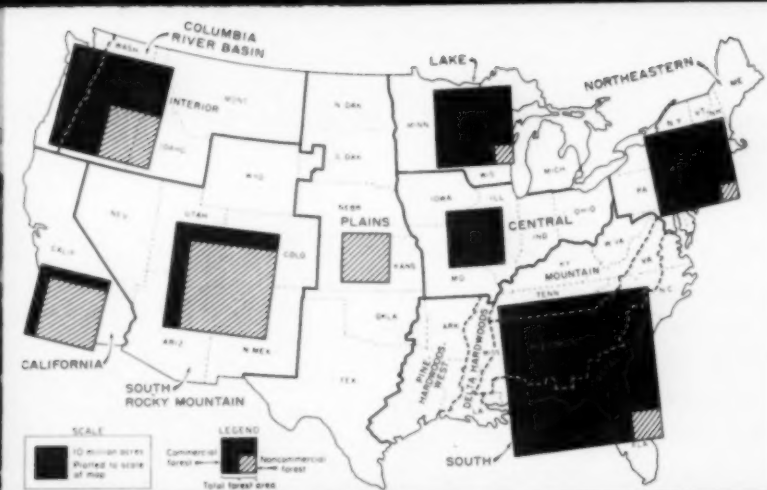
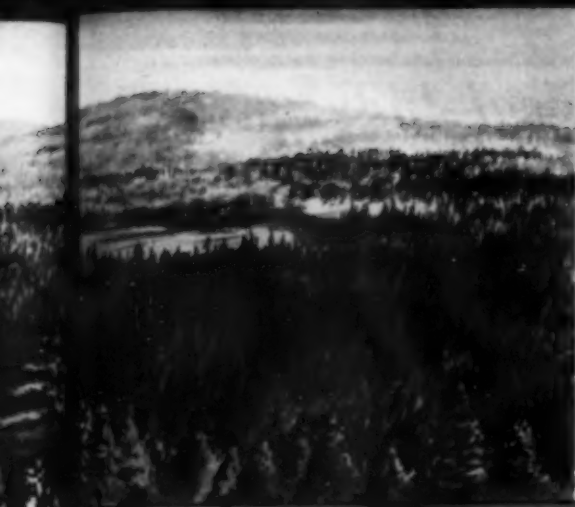
FROM AMERICAN FORESTS

Annual Consumption	Tons of Dry Wood
LUMBER (4 lb. per board ft.)	68 million
SAWMILL WASTE (1 ton per M board ft.)	34 "
FOREST WASTE	100 "
PULP MILLS	13 "
FUEL	80 "
	295 million



TS

These Chemical Process Industries



RAW MATERIALS

Basic Seven of the Chemical Industry

The chemical industry can be likened to a series of inverted cones resting on their apices, all with altitudes stretching upward toward infinity. The points of rest are the basic raw materials, strikingly few in number: salt, sulphur, components of the atmosphere, water, limestone, petroleum and coal. The altitudes are a function of the research imagination, engineering ingenuity and managerial initiative of each industry cone.—*Editors*

STARTING with any one of the basic raw materials, an ingenious chemical manufacturer can make several primary products and from these a dozen or more secondary products of commerce. By further chemical reactions, hundreds or more of tertiary and higher reaction products and byproducts can be synthesized. Thus have new chemical industries been created, thus still more will be created at an ever-increasing tempo. The end is nowhere in sight, for only within comparatively recent years, principally since the mass emergence of industrial organics, has the industry boldly trod into that vast domain of tertiary derivatives.

All this from less than a dozen basic raw materials produced by the mines and fields and forests of the land—mineral ores, salts from brines, sulphur, components of the atmosphere, coal, water, limestone, petroleum and natural gas, selected products from living plants and animals.

BASIC SEVEN

Salt is one of the backbone raw materials of the heavy chemical industry, the source of such primary products as caustic soda, chlorine, hydrogen, metallic sodium and muriatic acid. Now the

ocean, for countless ages a collector of chemical salts, is being forced to give up in quantity bromine and magnesium as well as salt.

Free sulphur occurs as one of the unique resources of the Texas and Louisiana area as a bed 500-1000 ft. below the earth's surface. Sulphuric acid, most important of the sulphur derivatives, is basic to the chemical industry and its production has been said to be the bellwether of all industry. Limestone, of course, is necessary for calcium carbide which fathers a multitude of products, grand-products and great-grand products on the organics side of the chemical family.

Another basic raw material in the chemical industry is air, the constituents of which are separated by fractional distillation. Tremendous quantities of air are processed annually and this business has become a profitable part of the chemical industry. Within the past two decades, nitrogen of the air has become the source of most of our vital ammonia, nitric acid and nitrogen fertilizers, products as essential during peace as during war.

So far, our discussion has been limited to inorganic raw materials and compounds. Yet there are over 300,000 organic compounds now known as compared to only about 90,000 compounds of all the other elements put together. And still the known number of organics is growing at a tremendous rate, each a potential tertiary chemical commodity of commerce.

Raw materials for the organic chemicals industry are derived principally from coal, natural gas and petroleum. Some, however, have their origin in sugar, cellulose, lignin, starch, protein, plant and animal fats and waxes.

Byproduct coke and coal-tar production rose to an all-time record high in this country in 1943. Of the byproducts, the largest increases were made in the production of benzol, toluol, naphthalene, phenol and cresols, pyridine, quinoline, and various derivatives of these. Benzol was converted to phenol synthetically

in huge quantities. Coal-tar benzol, toluol and phenolic compounds have now been supplemented very extensively by the same products derived from petroleum.

Benzol and naphthalene are oxidized to produce great quantities of maleic anhydride and phthalic anhydride. These, in turn, are used to produce plasticizers, textile treating agents, alkyd synthetic resins for coatings, and a host of other specialty products.

Benzol, toluol, and naphthalene are the raw materials for the preparation of most of our synthetic dyes. Coal-tar products are also the major raw materials for preparation of pharmaceuticals such as aspirin and acetophenetidin from phenol; sulfanilamide and all its derivatives from aniline, and the anti-malarial, atabrin.

There has recently been a greatly increased demand for products from coke and calcium carbide, methanol and higher alcohols, formaldehyde, acetic anhydride, acetic acid, acetaldehyde and derivatives, the vinyls which go into plastics and neoprene synthetic rubber. Many of our organic "heavies" fall into this category of coke-carbide derivatives.

PETROCHEMICALS

Petroleum and natural gas are actually just coming into their own as raw materials for chemicals. In fact, this swing toward the large-scale use of petroleum and natural gas for the synthesis of commercial organic chemicals is the outstanding recent trend in the industry.

During the last decade and especially in the last five years, the petroleum industry has developed methods for reacting raw materials and separating the products into relatively pure compounds. These form the basis of a great deal of our fighting strength as well as of our future peacetime stability. Whereas products from some other natural sources have proved difficult to expand in the present emergency, the

chemical utilization of petroleum and natural gas has opened the way to a tremendous production of basic organic chemicals considered impossible a few years ago.

Liquid fuel for airplanes and tanks now consists of a definite blend of relatively pure synthetic organic chemicals prepared from petroleum: 2, 2, 4-trimethylpentane, isopentane and neohexane, together with small amounts of tetraethyl lead and ethylene dibromide. Production of this fuel has been expanded at a tremendous rate.

Although liquid fuel probably will continue to be the main volume product of the petroleum industry, the production of certain petroleum-derived chemicals has already reached large proportions and great value in our economy. These products include formaldehyde and pentaerythritol from methane; alcohol, ethylene oxide, ethyl chloride, the ethanalamines, glycol, styrene, and acrylonitrile from ethylene; butadiene from alcohol and from butenes; isopropyl alcohol, acetone, allyl alcohol and glycerin from propylene; butyl and amyl alcohols from butylene and amylenes.

It has been found possible to cyclize the straight chain compounds of petroleum, particularly hexane and heptane, to form cyclic compounds such as benzol and toluol whose sole source formerly was byproduct coal tar. This is fortunate, for the military demands for toluol for T.N.T. have exceeded anything dreamed of 10 years ago.

Phenol and creosols derived naturally from coal tar would have been but a drop in the bucket compared to the present demand for these chemicals for plastics. However, benzol from coal tar supplemented by that from petroleum, has been converted in tremendous quantities by an oxidation process into phenol. In 1943, the production of synthetic phenol was estimated to have been more than 20 percent over the total synthetic and natural production for 1942. This has been supplemented also by considerable synthetic phenolic compounds produced directly from petroleum by new processes.

The plastics industry is an example of a field which has grown up and out of organic chemicals derived from both coal tar and petroleum. As a direct result of the necessitous demands for production of war products, it has emerged from an industry of many small uses to one of some very large uses. Production has grown almost overnight from a status of statistics in pounds to one of statistics in tons.

Among the large-scale uses of resins may be listed that of certain types of phenol-formaldehyde and of urea-formaldehyde materials as adhesives in

the production of plywood. This has proved to be very useful in the production of light airplanes, such as Britain's Mosquito bomber. In peacetime it will probably be useful for the production of boats, furniture, housing units, and a thousand and one other uses besides the production of airplanes.

Nylon, also based on phenol as an intermediate, is now used in the production of parachutes and of strong but light ropes and tackle of all kinds. Nylon can be used as a molded plastic; increased use is expected along these lines after the war. Production of nylon is now probably equal to the originally projected 20 million pounds per year.

Vinyl resins derived from calcium carbide and acetylene have expanded tremendously in all sorts of uses. Production of the vinyl chloride-vinyl acetate copolymers approached 50 million pounds a year. Besides these, other vinyl resins made on a large scale include polyvinyl alcohol and polyvinyl butyral, production of which has doubled since 1941 and then doubled again.

Polyvinylidene chloride is a relatively new and promising plastic derived from ethylene and chlorine. It produces a very strong and weather-resistant fiber for use in screens, tents for the tropics and upholstery for furniture.

CHEMURGIC PRODUCTS

Chemurgy has received considerable impetus from the establishment of four Regional Research Laboratories of the U. S. Department of Agriculture. In the last few years these laboratories have developed processes for methylacrylate resins from lactic acid, butadiene from corn, natural rubber from numerous shrubs, and a rubber substitute known as norepol from soybean oil and glycol.

The fermentation industry, probably the world's oldest chemical industry, is still going strong. Recently it has been converted in this country from the production of whiskey to the production of industrial alcohols. After the emergency it may be expected that the fermentation industry will swing back to whiskey production, partly because of the demand but also because industrial alcohol from other than grain is cheaper. Alcohol from ethylene can also compete successfully with alcohol from cheap byproduct molasses.

Other chemurgical industries include those built on edible fats from vegetable oils and the production of soap and glycerin. These processes have not changed much in 150 years except for the addition of hydrogen to cottonseed oil to give an edible cooking fat and the withdrawal of the elements of water from a molecule of castor oil to give

synthetic drying oils for the replacement of tung and linseed oils in paints and varnishes.

Many products have been developed recently from the rosin and turpentine obtained from pine forests in the South. Development of a chemical process for making satisfactory pulp from Southern pines has created a typical chemurgical industry. This process should slow down the rapid conversion of the continent's spruce forests into paper pulp.

BUT . . .

Chemurgical industries, however, ordinarily require expensive human labor to grow crops, to plant, tap and take care of trees, even to lumber them. Where the same material can be produced from petroleum or natural gas or other available natural resources as well as from farm or forest products, the use of petroleum or natural gas or coal tar has usually proved in the end to be more economical. Examples flash up immediately: indigo and other synthetic dyes from aniline, ethyl alcohol from ethylene, butadiene from either butylene or ethylene alcohol, nylon from coal tar and petroleum raw materials. Even soap is meeting increased competition from synthetic detergents.

Where the products of chemical operations have come into competition with natural products, the synthetic chemicals usually have enjoyed the following advantages: (1) A constant quality which tends to improve; (2) a stable price which tends to decline; (3) unique chemical and physical properties not available in natural products.

Although usually higher priced to start with, the synthetic materials in nearly every instance have won acceptance. As quantity production increased, costs have been lowered until the natural product could be undersold even under the most favorable circumstances.

We may actually be in the process of proving this very point in the case of synthetic versus natural rubber—but much more rapidly on account of the war than would otherwise be the case. The only factor which seems to keep natural rubber in the picture is that of extremely cheap labor in the Far East. With the general advance in standards of living expected in that area after the war, this kind of labor may be expected gradually to disappear. Natural rubber will be produced, but more efficiently and at a higher cost. The expected trend will be to use it nearer to the producing areas.

This picture for the production of chemicals, especially of organic chemicals from coal and petroleum, is very bright indeed.

FARM PRODUCTS

Their Utilization as Industrial Raw Materials

Coming as a boon to both agriculture and industry, new technological developments in chemurgy portend greatly expanded industrial utilization of raw materials from American farms. Many products are now usable in industry as the result of extensive research in the past decade. New industrial markets thus opened to farmers suggest a more stable rural economy with less likelihood that bumper crops will be dissolved in ruinous prices.— *Editors*

PROCESSING agricultural products is a truly basic industry; it has always been and will continue to be one of the most important industrial activities of man. Productivity of the farms of this country is enormous, and with intelligent management of our soil and with continued fruitful research we can harvest huge crops indefinitely.

But this very productivity has itself

raised a serious problem, the problem of surplus. During the war years large demands for food, feed, and fiber have erased most surpluses, but with the coming of peace we may look forward to the reappearance of huge amounts of unwanted farm products. Past experience shows that overabundance is most likely to arise in cotton, tobacco, cereals (particularly corn and wheat),

fruits, vegetables, and oil seeds. All of these and many others are on hand in sufficient quantity to serve as significant sources of industrial raw materials after all the normal food, feed, and fiber requirements have been met. Furthermore, more than 200 million tons of fibrous residues accumulate annually as normal byproducts of agriculture; while some of this large tonnage might profitably be returned to the soil, much of it is potentially available for industrial use. It is the purpose of this discussion to evaluate those technological developments which may relieve the surplus situation by making profitable the industrial utilization of some of these materials.

Notable advances have been made in the technology of farm product utilization during the past 30 years, and particularly during the last 10 years. Many industries are in operation today as the direct result of research achievements. Textiles, starch and its derived products, paints, varnishes, ethanol, acetone, organic acids, leather goods, plastics, adhesives, industrial oils, detergents, furfural and many other products have long taken millions of tons of farm products annually. More recently, industries have grown out of improved processes for making these old products and entirely new processes for making brand new products. Some of these include: improved detergents, crystalline dextrose, furfural, new fatty acid derivatives, soybean and casein fibers, and new fermentation products such as butanol, acetone, fumeric, and citric acids.

Laboratories directed by industry, government, and the universities of the country have conducted the research which has fathered these agricultural offspring. In general, research has centered about four phases of the problem.

(1) Increasing fundamental knowledge of the chemical and physical properties of important constituents of agricultural raw materials.

(2) Developing new fermentations and improving fermentation methods already in use.

Checking operation of pilot plant for recovering starch from grains



(3) Processing oil seeds, cereal grains, and tubers.

(4) Developing chemical engineering processes involved in these and other operations.

Specific developments with respect to a number of agricultural and industrial materials is detailed in the progress report which follows.

Within the past 10 years much valuable information has been accumulated on the structure of starch. This is beginning to lead to a better understanding of the behavior and properties of this important industrial material. One of the most significant advances in the field of starch has been the definite establishment of the existence of two major fractions in most of our commonly occurring starches. This delineation has been made possible by the development and perfection of improved methods of fractionation. It is now believed that one of these fractions, amylose, is made up of linear unbranched chains; while the other fraction, amylopectin, by reason of its behavior is thought to consist either of highly branched or folded or corpuscular chains. From consideration of the structure of these two starch fractions, it would appear that the amylose fraction, for example, should be capable of forming fibers and films; whereas this should not be the case with the amylopectin fraction. This has been borne out quite recently by experimental work which demonstrated that amylose acetate is capable of being spun into fibers and of forming strong films. Furthermore, some of the differences in the gel characteristics of starches can now be explained on the basis of their amylose and amylopectin components. Methods of analysis have been developed for the determination of the relative quantities of these two fractions present in any starch. These new concepts of starch structure, resulting from the successful fractionation of various starches, are opening up an entirely new field in the chemistry of starch and should lead to very fruitful practical applications in the industrial use of starch and its derived products.

Because of the shortage of tapioca starch resulting from the cutting off of imports from the Dutch East Indies, waxy or glutinous corn and sorghum starches have been developed as commercial products over the past two years. Approximately 15,000 acres of waxy corn have been planted under contract during this last year and will be processed into glutinous starch for special industrial uses. Considerable quantities of glutinous sorghum starches are also expected to be produced for special uses in the food field. The glutinous starches represent an entirely

new development and one which will be very interesting to watch.

Another significant innovation in the starch industry during the past year has been the large-scale industrial application of methods developed through a decade of research for the production of starch from sweet potatoes. A larger plant, capable of producing approximately 50 million lb. of sweet potato starch per year is now in the process of erection.

The use of wheat for the production of starch and glucose syrup has been another development of the past two years. New methods have been perfected to process either the whole wheat kernel or granular wheat flour by relatively simple means which give excellent yields of starch and byproduct gluten. It is understood that all current wheat starch production by the new processes is being utilized for hydrolysis to glucose syrups, while the gluten is used to make sodium glutamate.

Much progress is also being made in the chemistry of fats and oils. Considerable information is now available on the composition of the glycerines present in many of our common fats and oils. In addition, better understanding and control has been gained of reactions involving the ethylenic linkages present in the unsaturated fatty acids. Research now under way in a number of laboratories should make it possible to develop controlled reactions whereby maximum use might be made of the polymerization characteristics of

unsaturated glycerides thus leading to improved paints and varnishes.

A number of new fatty acid derivatives are now in commercial production, and more may be expected because of our better knowledge of the chemistry of long-chain fatty acids.

One of the more significant developments, particularly in the chemical engineering aspects of fats and oils processing, is the improvement of liquid-liquid extraction procedures whereby the glycerides of vegetable oils may be separated into two components, one more highly saturated and one more highly unsaturated than the original oil. These same techniques may be applied to methyl esters of the fatty acids present in any given oil and result in fractions more suitable, on the one hand, for utilization in fields involving polymerization processes, and on the other hand, for use in the edible oil or other fields where more saturated fatty acids are desired. This development should make possible a more economic utilization of fats and oils in more widely diversified fields.

The application to fats and oils of a number of concepts of high-polymer chemistry has also been fruitful of practical results and should prove more so as time goes on. Thus processes have been developed for the dimerization of linoleic and linolenic acids and the polymerization of their ethylene glycol, ethylene diamine and other difunctional derivatives to end products having interesting application in the broad

Note elasticity of rubber substitute being milled from vegetable oil



helds of elastomers, coatings and plastics.

Considerable research is under way on the development of new and improved fibers from some of our more common proteins such as those derived from soybeans, peanuts, milk and corn. While our knowledge of the physical and chemical structure of proteins is slowly being developed through basic research, it is still too scanty to permit a rational approach to the problems involved in producing high-quality fibers from plentiful proteins. However, research in a number of laboratories is making important progress toward effecting practical improvements in the preparation of raw material, in spinning procedures, and in orientating and hardening the finished fibers.

The past 10 years have witnessed the development of commercial production of soybean protein, and this material is finding increasing use in the adhesive and coating fields. Research under way on the improvement of protein adhesives and coatings should lead to more extensive uses for this type of material.

Over the past 30 years, important advances have been made in the field of industrial fermentations. Basic investigations over a period of years in a few laboratories in this country laid the groundwork for the recent spectacular development of the industrial production of penicillin by mold fermentation. The penicillin development has stimulated a wide interest in the use of micro-organisms as agents for the production of complex organic compounds from agricultural raw materials.

The strategic importance of ethyl alcohol in the present war, particularly as it relates to the production of butadiene for the synthetic rubber industry, has brought this important industrial organic chemical very much to the fore. At the present time, more than 50 percent of all butadiene being used in the synthetic rubber program is derived from alcohol, 90 percent of which, in turn, is produced from agricultural materials. Because of feeding requirements for the bumper corn crops of recent years, it has been necessary for the alcohol industry to turn to a variety of raw materials, including wheat, grain sorghum, rye and potatoes to satisfy the huge demand for alcohol. In addition to using a multitude of raw materials, the industry also has had to revert to distilleries ranging from those which are large, modern and well-equipped to those which are small and comparatively inefficient. All this variety has meant headaches during the past few years, but the experience gained should prove invaluable as time goes on. Operating data now on hand have already led to improvement of



One of the new traffic paints using soybean oil goes through a three-roller paint mill

certain operations involved in grain cooking, malting, and byproduct feed recovery. Also, it should now be possible to estimate closely the costs of producing alcohol under any conditions.

Production of butylene glycol by fermentation of various carbohydrate materials has not come into commercial operation during the war, but complete data have been accumulated on all aspects of the process, including exhaustive pilot plant runs.

Lactic acid has received increasing attention over the past six years as a starting material for industrial organic chemical synthesis. Important advances have been made in two directions: first, in the economic recovery of this acid, its salts and its esters from dilute fermentation liquors; and second, in the conversion of lactic acid derivatives to acrylic acid esters. Considerable information is now at hand with reference to the interesting properties of a wide number of elastomers and plastics, representing copolymerization of acrylic acid derivatives with a variety of organic compounds.

Laboratory and pilot plant studies have been completed on a process for the continuous saccharification of agricultural residue materials such as corn cobs, bagasse and cottonseed hulls. The novel feature of this process is that the dextrose and xylose solutions are recovered in two separate streams, each in the range of 10 to 15 percent concentration. Lignin is recovered as a byproduct. Small pilot plant operation data indicate, for example, that three tons of corn cobs would yield approximately 2,000 lb. of dextrose, 1,800 lb. of xylose, and 1,000 lb. of lignin. It is

expected that this process will be thoroughly evaluated, on a semi-works scale basis. It offers the possibility of cheap sugar solutions for solvents as well as furfural production. While it is not known whether the process could be applied to wood wastes, this possibility will not be overlooked particularly with reference to the hardwoods which contain appreciable quantities of pentosans.

Intensive research programs are under way in a number of laboratories with the objective of improving cotton in all of its manifold uses. Breeding of improved varieties, development of one-variety communities, improvement in harvesting and ginning operations, development of basic information with respect to the physical and chemical properties of the fiber, improvement of textile machinery and processing operations, investigation of new chemical treatments for cotton goods, development of cotton tire cords with much improved performance characteristics—all are directed toward increasing even further the utility of this nation's largest cash crop. While cotton still accounts for almost 70 percent of all of the textile fibers used in the world today, it is receiving increasingly keen competition from synthetic fibers. Intensive research on the improved utilization of cotton has been under way only in recent years. We are only beginning to develop basic data on the strength, elasticity and other properties of cotton fiber and the relation of these properties to varieties and cultural methods as well as to specific end uses. We may be sure that this information will have outstanding usefulness in improving our current utilization of this important fiber and in the development of new uses.

Industry looks to certain qualities in raw materials which it expects to use. These include among others cost, availability and suitability for the purpose under consideration. If agricultural raw materials are to enter into industry in large volume, they must do so either because they are cheaper than other available raw materials or are superior to them. While chemical and engineering research such as that alluded to briefly in the preceding paragraphs is pointing the way for much improved and widely varying new uses for agricultural products, economic factors such as the quality and quantity of raw materials, their suitability for processing, their competitive position relative to petroleum, natural gas, coal and other raw materials will be determining factors in deciding whether such research results can be translated into commercial processes and products.

WOOD

Chemical Engineering Raw Material

In exploiting the raw material which exists so abundantly in our forests, it is unfortunate that even today more tons of wood are wasted than are finally transformed into lumber or pulp. While lumber and pulp will continue to be the major products of the forest, the future prosperity of the industry depends upon the degree to which this extraordinary wastage can be transformed into the production of profitable chemical products. The possibilities of effecting this transformation are enormous, and Dr. Hall looks forward to the development of a completely integrated industry embracing all phases of forest utilization from the forest itself to the allied chemical and industrial plants.—Editors.



Large lumbermill in Idaho with refuse burner in background burning up perfectly good chemical engineering raw material. Utilization of this wasted wood is the goal of an intensive research program now under way at the Forrest Products Laboratory in Madison, Wis.

IN GROWING saw logs and converting them to lumber, it is a painful fact that less than a third of the wood produced ever gets to market as lumber. About a ton of wood per thousand board feet of lumber is left at the sawmill as sawdust, slabs, and edgings, while about three tons are left in the woods as tops, limbs, broken and cull logs, cull trees, and non-commercial species. This wood is perfectly good chemical raw material. There is no determinable chemical difference between a piece of white pine top wood and a clear piece of white pine lumber. But lumber carries the cost of transporting the log to the mill and making the sawmill waste. Saw logs carry the cost of growing the wood left in the forest. This waste wood at the mill is already col-

lected. Methods are being developed for the cheap collection of the forest waste. Cheap and abundant wood is the objective, with lumber continuing to carry most of the cost.

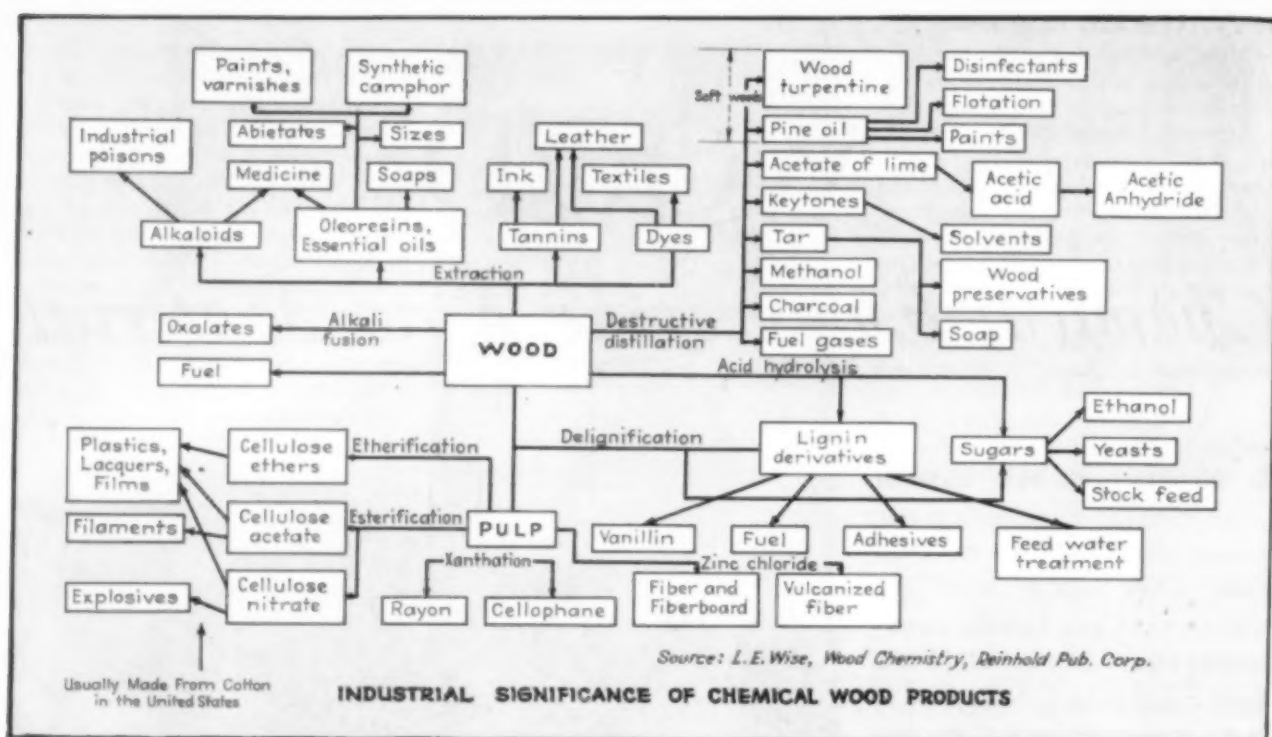
Sawmill waste must be burned to get it out of the way. Forest waste cumbers the ground, interferes with growth and reproduction, and creates fire hazard. Its removal from the woods can actually carry some cost as an end in itself. Furthermore, balanced cutting of trees now unmerchantable as lumber in order to use the wood as a chemical will increase the yield of lumber quality wood.

Hitherto, the lumber industry has been a one product industry. Likewise, the pulp industry has pretty consistently avoided any byproducts utilization. Yet it seems to be a reasonable probability that diversified wood utilization, taking

the forest crop as it comes, using those portions of it for those uses to which they are best suited, might work better—i.e., lumber quality wood for lumber, pulpwood for pulp, chemical wood for chemical uses. Carrying the principle still further, wood ought to be used as a base for a whole line of chemical goods, not for a single product.

It follows that a chemical industry based on wood will have a greater chance of success if it is closely integrated with a complete forest products industry, including ownership of the basic resource, the forest itself. This principle is being recognized in numerous quarters, although there is still too much tendency toward narrow specialization, especially in the pulp industry.

The sulphite pulp industry has been compelled to be rather critical in its



selection of wood supply. As a result of high grade selection of species and qualities, wood supply for sulfite mills is now inadequate in many instances and no immediate relief is in sight. This is bound to force conversion of sulphite mills to pulping processes that are less critical of wood properties, and in turn, force the development of pulping techniques that can supply high quality pulps from woods not hitherto used for such purposes. There is considerable promise that processes now in the development stage will fill the bill.

Only about half of the wood coming to a sulphite mill emerges as pulp. The rest goes out as effluent, the solid content being about half lignin and half carbohydrate. Wartime developments give healthy promise of profitable conversion of a major part of the carbohydrate content to various products of fermentation. Some utilization of the lignin content in plastic and chemical manufacture is under way. At least one major factor in the industry is planning postwar conversion to magnesia-base sulphite procedure, with utilization of the carbohydrate content of the liquor by fermentation, and recovery of the fuel values in the lignin as power. This particular industry needs the power in the rest of its rather well integrated layout. It will solve its stream pollution problem and part of its power problem by the conversion.

The Kraft industry, thus far, has shown little development of the differentiated wood utilization, preferring to operate on a short pine growth rotation

for exclusive pulp production, with very little byproduct recovery. It seems probable that, as time goes on, the profitable integration of pulp wood production with sawtimber, poles, piling, and naval stores will become apparent. A narrower margin of profit on kraft pulp will eventually force this development and recovery of the turpentine, rosin, and fatty acids that are byproducts.

Important wartime developments have shown new ways of utilizing lignin from the alkaline pulping processes in the production of lignin-filled compressed paper goods with rather remarkable properties. This may develop into an outlet for large tonnages of recovered alkali lignin.

New pulping processes, such as the semi-chemical processes and the "holo-cellulose" process of the Forest Products Laboratory at Madison, offer promise as sources of cheap pulp from a broad wood supply base. They are also promising as sources of dissolving pulps that can be produced from superabundant raw materials.

Cheap wood waste, some 125 or 150 million tons a year, offers considerable opportunity as a chemical industrial base. Current hydrolytic processes yield from 1,000 to 1,200 lb. of sugar per ton of wood, with attendant production of significant quantities of furfural, acetic acid and methanol. This crude sugar solution is a chemical raw material of real promise. It is obtained as a 5-6 percent solution and, on a basis of postwar cost, should cost about \$0.006 per lb. of sugar with no credit for byproducts.

Credit for presently salable byproducts should reduce this figure, and if sufficient values can be realized from the 500-600 lb. of lignin produced per ton of wood, it may be very low indeed.

Wartime research on wood sugar at the Forest Products Laboratory has been aimed at production of alcohol. Wood sugar from coniferous woods is about 80 percent fermentable to alcohol and remarkable progress has been made by the Laboratory, both in reducing time of hydrolysis and time of fermentation.

However, postwar developments may be expected to be in the direction of widely diversified uses for coniferous wood sugar in chemicals production and the use of hardwood sugar for similar purposes. To catalog all possibilities of single and double fermentations based on this mixture of pentose and hexose sugars would be merely to catalog the fermentation industries. The key to the whole prospect is cheap sugar and, cheap as it already is, it may become much cheaper as lignin becomes a profitable product.

Lignin from wood hydrolysis by the process developed at the Forest Products Laboratory is not, per se, a very promising material for plastics. But it is a promising material for the production of some chemicals already in mass production, and others not sufficiently well known as yet to have gained a market. Significantly, the plywood industry, the new industries based on "papreg" and "compreg" and others are very large users of the phenols and other resin-forming chemicals produced by the hy-

drogenolysis of lignin. The whole future of the industry based on impregnation of wood and paper with resin-forming chemicals depends upon cheap resin-forming chemicals. Wood itself may prove to be such a source, especially if costs can be distributed over a broadly differentiated wood industry, integrated with the forest and within itself.

Lignin also offers promising possibilities along other lines leading toward coating specialties and similar products.

The wood distillation industry, dealt heavy blows by synthetic methanol and fermentation acetone, has survived where close utilization of products and cheap wood have been combined. New continuous distillation techniques, better control of distillation conditions, and adaptation of the industry to the cheap waste wood piles may be expected to lend stability, but no great expansion seems likely. Metallurgical charcoal, in heavy demand during war, is expected to resume normal volume in peace.

The successful complete wood chemical industry will not be a unit in itself; it will be associated with the forest, a sawmill, a planing mill, a veneer and plywood plant, a pulp mill, perhaps a wood distillation plant, and such specialty plants as may be advisable. A large proportion of the market for its products may be found in the wood products of its associated industries.

Narrow specialization of industrial use of wood is contrary to the most profitable forestry. Well differentiated industrial use of wood can make intensive forest management profitable.

There are three characteristics that distinguish wood as a raw material for chemical engineering:

- (1) It is a perpetually renewable resource, of the same kind and in the same place.
- (2) Chemical wood can be a byproduct of forestry, the principal product being lumber.
- (3) The methods used in harvesting the wood crop determine the nature of future crops.

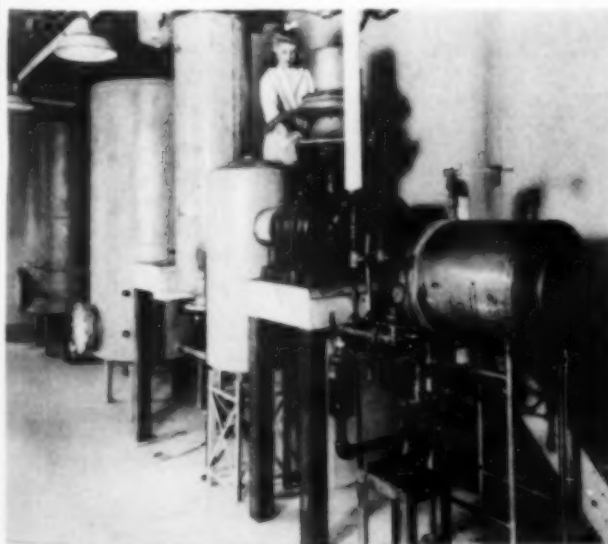
The last few years have shown that chemical engineers might well profit from an elementary knowledge of forestry and that foresters might profit likewise from an understanding of the simpler elements of chemical engineering operations. Furthermore, it would seem to be a sound assumption that the permanence of a resource is some inducement to base an industry upon it.

The wood resource is large in continental United States. We have 630 million acres of forest land covered with a broad diversity of species of trees. The sawtimber resource is not being maintained for the simple reason that we are cutting saw log sized trees faster than trees are growing into saw log size. We are harvesting now at the rate of about 34 billion b. ft. of lumber per year, faster than we are growing board feet. We are also bringing to the pulp mills about 13 million cords of wood annually and use for fuel about 71 million cords. In tons of material, rather roughly, this volume of material adds up thus:

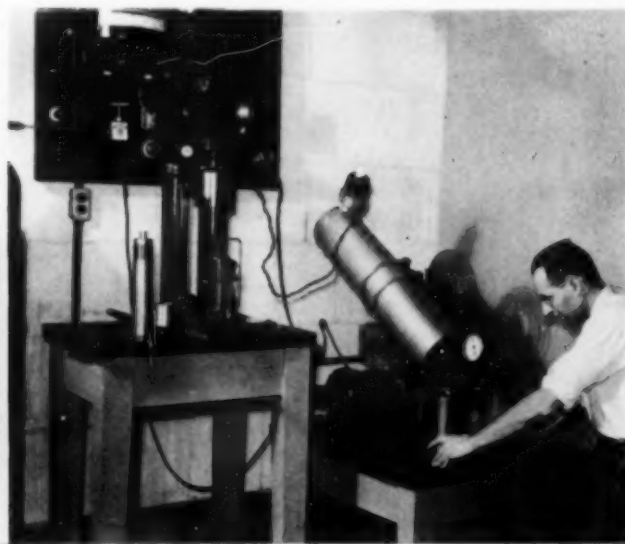
Annual Consumption	Tons of Dry Wood
Lumber (4 lb. per b. ft.)	68 million
Sawmill waste (1 ton per M b. ft.)	34 "
Forest waste	100 "
Pulp mills	13 "
Fuel	80 "
	295 million

It appears that, disregarding certain minor uses and using the above rather conservative assumption of 100 million tons a year of waste left in the woods, we are harvesting, or at least withdrawing from growth on the average slightly less than half a ton of wood per acre per year. About 23 percent of the gross by weight is lumber, but it is probably safe to say that this 23 percent represents over 50 percent of the total value of crude forest products. This arises largely from the fact that the two waste items, sawmill and forest waste, command little or no value except a limited use as sawmill fuel. Thus, lumber bears the major cost of the forest enterprise.

Although we are withdrawing from growth about a half ton per acre per year and probably are not growing that on the average, this does not present a true picture of the possibilities. There is no question that annual growth per acre of wood volume could be easily doubled on at least two-thirds of our forest acreage if reasonably sound forest management were used. It is encouraging to note that increasing numbers of owners of forest land, few in proportion to the total, are beginning to practice reasonably adequate management, and there is reason to believe that our annual wood crop can be considerably increased. Certainly there is no reason to believe that it will fall much below its current level. Diversified utilization may be expected to encourage intensive management. As long as the sun shines and the rains fall, we need suffer no shortage of wood, produced on land that cannot be put to other profitable employment if we give some reasonable forestry care to the growing crop.



Fermenters in the wood hydrolysis pilot plant at Madison. Wood sugars from coniferous woods are about 80 percent fermentable to alcohol.



Experimental work with this hydrogenation bomb is aimed at developing methods for producing cheap resin-forming chemicals by the hydrogenolysis of lignin.

MINERALS

Firm Foundation of Midwest Industries

Wartime research in university and industrial laboratories has stimulated progress in the utilization of midwestern resources—again emphasizing the intimate inter-relations of the mineral and chemical industries. Their future growth is dependent upon newly developed skills, in turn dependent upon economic, social and political trends.

AMERICA'S "inner industrial fortress" is a practically self-sufficient empire of industry and agriculture. Its area includes that of the fourteen states that form the great valleys tributary to the Mississippi north of the southern boundaries of Kansas, Missouri, Kentucky and West Virginia. Here is found a unique combination of mineral resources and agriculture, intelligent labor and technological skill, capital and markets.

Industry in this great Midwest Empire began with the utilization of the products of the soil although mining soon became

a profitable source of income. Then followed a period in which the products of mines were processed for higher values, crudely at first but with increasing efficiency as chemical engineering developed new technological skills. Today a large proportion of the chemical process industries are dependent upon midwestern raw materials and the results of research in their utilization.

In considering the future of chemical industry in the Middle West it seems obvious that the trend will be in greatly increased utilization of native resources, particularly of mineral raw materials.

There is scarcely an important chemical manufacturing process that does not depend upon one or more of the following materials, almost all of which are available in quantity in the Middle West: Coal and lignite, limestone and dolomite, salt, pyrites and iron ores, clays and bauxite, calcium and magnesium brines, petroleum and natural gas, silica, fluor spar, lead and zinc ores, barytes, manganese, gold and silver. The only chemically important minerals that are missing in quantity are potash, phosphates, sulphur, chromium and mercury. Fortunately these can be brought in cheaply by rail or by the lake and river waterways. This unexcelled transportation system becomes even more important as means of reaching world markets with the products of middle western industries.

The accompanying table attempts to summarize briefly the present state of development for the more important mineral resources of the fourteen middlewestern states. More detailed and exact information is available from the publications of the Bureau of Mines and the Geological Survey, both of the U. S. Department of the Interior.

This war has drastically changed many economic concepts, particularly in the Middle West. Capital charges may not mean as much as in the past, when government-owned plants and entire industries are made available after the war at arbitrary values for as yet undetermined uses. Governmental planners have also found that the economics of production can be vastly altered by the power to tax. International relations are going to have a lot to do with what is to be made and where. Cartels are to be the exclusive functions of government—with international negotiations and politics vying with technology in determining the future of manufacture and trade.

With such problems pressing for post-war solutions, it is difficult for anyone to predict the exact course of future developments. But it does seem certain that an area such as the Middle West which is so rich in natural resources, will have a still greater opportunity to develop and diversify its chemical engineering industries.

MINERAL AND CHEMICAL RAW MATERIALS AND INDUSTRIES OF FOURTEEN MIDWESTERN STATES														
	H. Dak.	S. Dak.	Neb.	W. Va.	Iowa	Kans.	Minn.	Ky.	Mo.	Wisc.	Mich.	Ill.	Ind.	Ohio
Coal		x	x	xx	xx	xx	x	xx	xx		x	xx	xx	xx
Petroleum				xx		xx		xx			xx	xx	x	xx
Nat. Gas				xx		xx		xx			xx	xx	x	xx
Pyrites		x					x					x	x	
Iron Ore							xx		xx	xx	xx		x	x
Copper											xx			
Barytes														
Clay	x	x	x	xx	xx	xx	xx	xx	xx	x	x	xx	xx	xx
Limestone		xx		xx	xx	xx	xx	xx	xx		xx	xx	xx	xx
Silver		x							xx		xx	x		
Dolomite					xx	xx	xx					xx		xx
Feldspar							x							
Gold		xx												
Nickel														
Lead		x			x	xx			xx	x		xx		
Manganese		x					x		x		x			
Mica														
Peat							xx				x	xx	x	
Salt Brines			x	xx		xx					xx			
Zinc					x	xx			xx	x		xx		
Barite									xx			x		
Fluorspar								xx				xx		
Lignite	x													
Potash			x											

x—small industry or unexploited deposit xx—well developed industry or large deposits

DDT

Fights Insects in War and in Peace

One of the most significant scientific developments during the war has been the discovery and exploitation of the remarkable insecticidal properties of dichloro - diphenyl - trichlorethane, better known as DDT. Already having scored a knockout blow to typhus in Italy, DDT shows promise of ushering in a happier era in both the insecticide field and in the science of preventive medicine. Because of its heartening potentialities, any technical advancement that will make this material more readily available all over the world will be of utmost importance. The Brothman continuous method herein described goes a long way toward streamlining the basic process, revived after nearly seventy years of oblivion.—Editors

PROBABLY the nearest approach to a single all-out weapon yet found in man's ageless fight against insects and insect-borne diseases is now in wide use on many battle fronts. Respected wherever Allied troops fight, DDT* has been a major factor in making the Anglo-American armies the most disease-free in all history. "DDT will be to preventive medicine what Lister's discovery of antiseptics was to surgery," states Lt. Col. A. L. Ahnfeldt, director, Sanitation and Hygiene Division, Office of the Surgeon General, who ranks it with the really great discoveries in medicine of the past century. Some say it will exceed penicillin in ultimate value.

* Initials for dichloro-diphenyl-trichlorethane, known in correct chemical circles as 2,2-bis (para-chlorophenyl) 1,1,1-trichloroethane.

Sometimes referred to as "the penicillin of the insecticides," it must be remembered that just as penicillin is no cure-all, neither is DDT a kill-all. It has definite limitations, certain disadvantages. Detail knowledge of its behavior is still meager; experimentation has actually hardly begun. Yet already many thousands of soldiers and European civilians still live because of the inevitable deadliness of this friend of man to typhus-carrying lice that caused over 3,000,000 deaths in Europe in World War I.

SEVEN DECADES OF DUST

History of DDT, in some respects, parallels that of penicillin: long neglect, a sudden awakening, intensive development under the gaffly of war. In 1874, one Othmar Zeidler, student in Strasbourg, synthesized DDT as a thesis chore, recorded his discovery in six lines in *Berichte*, lived and died without once suspecting that he had played with an insecticidal blockbuster.

For over sixty years those lines gathered the dust of neglect. Then, about seven years ago, Müller of J. R. Geigy A. G. of Basle, Switzerland, discovered the amazing insecticidal properties of DDT. In 1939 the Swiss potato crop was seriously threatened by the imported Colorado potato beetle. The firm of Geigy made available a DDT composition, later marketed as Gesarol,* and the potato crop was salvaged. The Swiss informed Geigy in New York of this development in 1941 but it failed to attract much interest, since the potato beetle is controlled in this country with cheaper lead arsenate.

In mid-1942 about 100 lb. of DDT were received from Switzerland. In October of the same year Geigy, New York, gave the U. S. Department of Agriculture results of tests with the material on a variety of insects. By this time the American military attache at Berne had shown interest in Neocid, Geigy's DDT-base lousicide.

* Geigy DDT compositions, marketed under the generic names Gesarol and Neocid, are covered by Brit. Patents 547,871 and 547,874 (Hughes, 1942) and U.S. Patent 2,329,074 (Müller, 1948). Initial application for a patent was filed in Switzerland, March 7, 1940.

Work on lousicidal properties of DDT was started in the autumn of 1942 by the U. S. Department of Agriculture, mainly at the Orlando station. Results were so spectacular that the Office of the Surgeon General and OSRD immediately became interested. The Cincinnati Chemical Works, a Geigy affiliate, was asked to begin manufacture of DDT. Pilot plant production was started during May, 1943, in Norwood, Ohio. Soon the raw material chloral hydrate, a medicine known best in disreputable quarters as "knockout drops," became the principal production bottleneck until WPB acted to remedy the situation.

Full credit should be given the Orlando researchers for their development of military uses for DDT compositions. These men worked non-union hours in order to have the material ready for use in the Italian campaign. Many service men and Italian citizens owe their lives to the successful race-against-time job of these 29 men and their directors.

THE ARMY LICKS THE LOUSE

A lousicidal composition of 10 percent DDT and 90 percent pyrophyllite extender in 2-oz., pepper-type cans was adopted by the Army on May 26, 1943. First field studies on the material were carried out that fall in North Africa, where it soon became affectionately known among the Arabs as "sleeping powder"—supreme compliment to a delousing dust! One can of DDT lousicide will free a soldier of lice for a month, whereas the pyrethrum-base powder known as MYL in use

Table I—Present and Prospective Producers of DDT

Present Commercial Producers	
Merek & Co., Inc.	Rahway, N. J.
Hercules Powder Co.	Parlin, N. J.
Cincinnati Chemical Works	Norwood, Ohio
E. I. du Pont de Nemours & Co.	Grasselli, N. J.
General Chemical Co.	Marous Hook, Pa.
Monsanto Chemical Co.	St. Louis, Mo.
Elko Chemical Works, Inc.	Clinton, N. J.
J. T. Baker Chemical Co.	Phillipsburg, N. J.
Sherwin-Williams Co.	Cleveland, Ohio
American Home Products Co.	Marietta, Ohio
Prospective Producers	
Pennsylvania Salt Mfg. Co.	Philadelphia, Pa.
Michigan Chemical Co.	St. Louis, Mich.
Pharma Chemicals Corp.	New York, N. Y.

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In considering the future of chemical industry in the Middle West it seems obvious that the trend will be in greatly increased utilization of native resources, particularly of mineral raw materials.

There is scarcely an important chemical manufacturing process that does not depend upon one or more of the following materials, almost all of which are available in quantity in the Middle West: Coal and lignite, limestone and dolomite, salt, pyrites and iron ores, clays and bauxite, calcium and magnesium brines, petroleum and natural gas, silica, fluor-spar, lead and zinc ores, barytes, manganese, gold and silver. The only chemically important minerals that are missing in quantity are potash, phosphates, sulphur, chromium and mercury. Fortunately these can be brought in cheaply by rail or by the lake and river waterways. This unexcelled transportation system becomes even more important as means of reaching world markets with the products of middle western industries.

The accompanying table attempts to summarize briefly the present state of development for the more important mineral resources of the fourteen midwestern states. More detailed and exact information is available from the publications of the Bureau of Mines and the Geological Survey, both of the U. S. Department of the Interior.

This war has drastically changed many economic concepts, particularly in the Middle West. Capital charges may not mean as much as in the past, when government-owned plants and entire industries are made available after the war at arbitrary values for as yet undetermined uses. Governmental planners have also found that the economics of production can be vastly altered by the power to tax. International relations are going to have a lot to do with what is to be made and where. Cartels are to be the exclusive functions of government—with international negotiations and politics vying with technology in determining the future of manufacture and trade.

With such problems pressing for post-war solutions, it is difficult for anyone to predict the exact course of future developments. But it does seem certain that an area such as the Middle West which is so rich in natural resources, will have a still greater opportunity to develop and diversify its chemical engineering industries.

MINERAL AND CHEMICAL RAW MATERIALS AND INDUSTRIES OF FOURTEEN MIDWESTERN STATES														
	N. Dak.	S. Dak.	Neb.	W. Va.	Iowa	Kans.	Minn.	Ky.	Mo.	Wisc.	Mich.	Ill.	Ind.	Ohio
Coal		x	x	xx	xx	xx	x	xx	xx		x	xx	xx	xx
Petroleum				xx		xx		xx			xx	xx	x	xx
Nat. Gas				xx		xx		xx			xx	xx	x	xx
Pyrites		x					x					x	x	
Iron Ore							xx		xx	xx	xx		x	x
Copper											xx			
Barytes														
Clay	x	x	x	xx	xx	xx	xx	xx	xx	x	x	xx	xx	xx
Limestone	x	x		xx	xx	xx	xx	xx	xx		xx	xx	xx	xx
Silver		x							xx		xx	x		
Dolomite					xx	xx	xx					xx		xx
Feldspar							x							
Gold		xx												
Nickel														
Lead		x			x	xx			xx	x		xx		
Manganese		x					x		x		x			
Mica														
Peat							xx				x	xx	x	
Salt Brines			x	xx		xx					xx			
Zinc					x	xx			xx	x		xx		
Barite									xx			x		
Fluorspar								xx				xx		
Lignite	x													
Potash			x											

x—small industry or unexploited deposit

xx—well developed industry or large deposits

DDT

Fights Insects in War and in Peace

One of the most significant scientific developments during the war has been the discovery and exploitation of the remarkable insecticidal properties of dichloro-diphenyl-trichloroethane, better known as DDT. Already having scored a knockout blow to typhus in Italy, DDT shows promise of ushering in a happier era in both the insecticide field and in the science of preventive medicine. Because of its heartening potentialities, any technical advancement that will make this material more readily available all over the world will be of utmost importance. The Brothman continuous method herein described goes a long way toward streamlining the basic process, revived after nearly seventy years of oblivion.—Editors

PROBABLY the nearest approach to a single all-out weapon yet found in man's ageless fight against insects and insect-borne diseases is now in wide use on many battle fronts. Respected wherever Allied troops fight, DDT* has been a major factor in making the Anglo-American armies the most disease-free in all history. "DDT will be to preventive medicine what Lister's discovery of antiseptics was to surgery," states Lt. Col. A. L. Ahnfeldt, director, Sanitation and Hygiene Division, Office of the Surgeon General, who ranks it with the really great discoveries in medicine of the past century. Some say it will exceed penicillin in ultimate value.

* Initials for dichloro-diphenyl-trichloroethane, known in correct chemical circles as 2,2-bis (para-chlorophenyl) 1,1,1-trichloroethane.

Sometimes referred to as "the penicillin of the insecticides," it must be remembered that just as penicillin is no cure-all, neither is DDT a kill-all. It has definite limitations, certain disadvantages. Detail knowledge of its behavior is still meager; experimentation has actually hardly begun. Yet already many thousands of soldiers and European civilians still live because of the inevitable deadliness of this friend of man to typhus-carrying lice that caused over 3,000,000 deaths in Europe in World War I.

SEVEN DECADES OF DUST

History of DDT, in some respects, parallels that of penicillin: long neglect, a sudden awakening, intensive development under the gadfly of war. In 1874, one Othmar Zeidler, student in Strasbourg, synthesized DDT as a thesis chore, recorded his discovery in six lines in *Berichte*, lived and died without once suspecting that he had played with an insecticidal blockbuster.

For over sixty years those lines gathered the dust of neglect. Then, about seven years ago, Müller of J. R. Geigy A. G. of Basle, Switzerland, discovered the amazing insecticidal properties of DDT. In 1939 the Swiss potato crop was seriously threatened by the imported Colorado potato beetle. The firm of Geigy made available a DDT composition, later marketed as Gesarol,* and the potato crop was salvaged. The Swiss informed Geigy in New York of this development in 1941 but it failed to attract much interest, since the potato beetle is controlled in this country with cheaper lead arsenate.

In mid-1942 about 100 lb. of DDT were received from Switzerland. In October of the same year Geigy, New York, gave the U. S. Department of Agriculture results of tests with the material on a variety of insects. By this time the American military attache at Berne had shown interest in Neocid, Geigy's DDT-base lousicide.

* Geigy DDT compositions, marketed under the generic names Gesarol and Neocid, are covered by Brit. Patents 547,871 and 547,874 (Hughes, 1942) and U.S. Patent 2,329,074 (Müller, 1943). Initial application for a patent was filed in Switzerland, March 7, 1940.

Work on lousicidal properties of DDT was started in the autumn of 1942 by the U. S. Department of Agriculture, mainly at the Orlando station. Results were so spectacular that the Office of the Surgeon General and OSRD immediately became interested. The Cincinnati Chemical Works, a Geigy affiliate, was asked to begin manufacture of DDT. Pilot plant production was started during May, 1943, in Norwood, Ohio. Soon the raw material chloral hydrate, a medicine known best in disreputable quarters as "knockout drops," became the principal production bottleneck until WPB acted to remedy the situation.

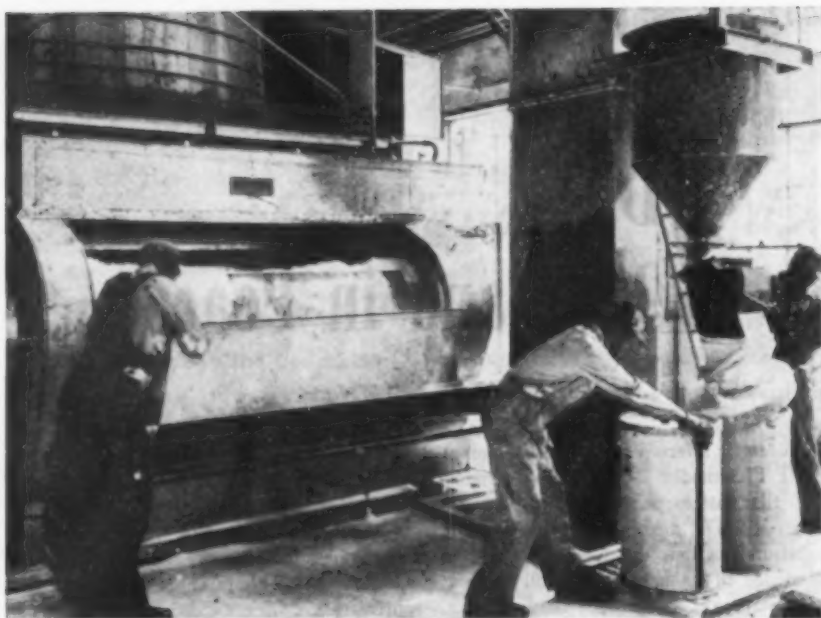
Full credit should be given the Orlando researchers for their development of military uses for DDT compositions. These men worked non-union hours in order to have the material ready for use in the Italian campaign. Many service men and Italian citizens owe their lives to the successful race-against-time job of these 29 men and their directors.

THE ARMY LICKS THE LOUSE

A lousicidal composition of 10 percent DDT and 90 percent pyrophyllite extender in 2-oz., pepper-type cans was adopted by the Army on May 26, 1943. First field studies on the material were carried out that fall in North Africa, where it soon became affectionately known among the Arabs as "sleeping powder"—supreme compliment to a delousing dust! One can of DDT lousicide will free a soldier of lice for a month, whereas the pyrethrum-base powder known as MYL in use

Table I—Present and Prospective Producers of DDT

Present Commercial Producers	
Merek & Co., Inc.	Rahway, N. J.
Hercules Powder Co.	Parlin, N. J.
Cincinnati Chemical Works	Norwood, Ohio
E. I. du Pont de Nemours & Co.	Grasselli, N. J.
General Chemical Co.	Marcus Hook, Pa.
Monsanto Chemical Co.	St. Louis, Mo.
Elko Chemical Works, Inc.	Clinton, N. J.
J. T. Baker Chemical Co.	Phillipsburg, N. J.
Sherwin-Williams Co.	Cleveland, Ohio
Warner Home Products Co.	Marietta, Ohio
Prospective Producers	
Pennsylvania Salt Mfg. Co.	Philadelphia, Pa.
Michigan Chemical Co.	St. Louis, Mich.
Pharma Chemicals Corp.	New York, N. Y.



First producer of DDT in this country was the Cincinnati Chemical Works, Norwood, Ohio, whose blending and packaging operations are here shown

at the war's beginning lost its effectiveness within a week.

Used in dust form, one pound of pure DDT can thus keep 80 soldiers louse-free for at least one month. And yet recent tests have shown that underwear treated with a DDT emulsion remains free of lice for over two months even after eight launderings.

The big test came during last December and January in Naples, where a dangerous epidemic of typhus broke out, carried by Italian soldiers returning from Yugoslavia. U. S. Army health authorities immediately began their fight against the louse. They dusted DDT down the backs and in the pants of 1,500,000 Neapolitans in less than a month and a half—new typhus cases plummeted from 60 to less than 10 a day. The dusting continued and until mid-March, some 2,225,000 persons had been treated. For the first time in medical history a mid-winter typhus epidemic was nipped in the bud!

According to Brig. Gen. Stanhope Bayne-Jones of the U. S. Army Typhus Commission, DDT may materially affect the history of the world by averting the usual war and postwar typhus epidemics. Imagine what this agent could have meant in the early 14th century, when 25-30 percent of Europe's population died of the Black Death, transmitted from rats by fleas. Highly effective against flies, DDT can also greatly ameliorate the age-old army diseases of diarrhea and dysentery. It is already proving itself highly effective in the field against the malaria-carrying mosquito.

Going whole hog on DDT, the Army is not content with having licked the louse. DDT compositions reported already in use or under test include a solution in alcohol

as a germicide, a five percent emulsion in oil as well as dust compositions as a mosquito larvicide for swamps, various sprays for controlling flies in depots, barracks and railroad stations, a 20 percent emulsion as a lousicide for clothing, and various compositions for barracks and hospital fumigation, kitchen sanitation, and bedbug control.

It has been reported that DDT has been approved to replace up to about 75 percent of critical pyrethrum in the 1-lb. aerosol bombs used principally for mosquito control in tropical areas. These bombs are being used in enormous quantities, Westinghouse alone having turned out some 10,000,000 by the middle of this year.

The Germans have apparently never made DDT and are now using an inferior product. The Russians use still another product but will soon be supplied with DDT on Lend-Lease, thus partly accounting for the size of the American production program.

PRODUCERS AND PRODUCTION

For the first eight months of the production program, until early 1944, the Cincinnati Chemical Works, Norwood, Ohio, was the sole commercial producer of DDT in this country. From September, 1943, to June of this year, this company increased its production sixfold. By this time it had made approximately 325 tons of DDT, enough to protect over 50,000,000 soldiers against typhus for a month.

By June, three more firms had begun commercial production: Merck & Co. at Rahway, N. J., Hercules Powder Co. at Parlin, N. J., and E. I. du Pont de Nemours & Co. at Grasselli, N. J. Hercules uses a converted unit which had previously

been making nitrocellulose for the British. At present there are ten commercial producers, with at least four other prospective producers in the pilot plant or development stages (see Table I).

After having widened the chloral bottle-neck, the chief task of WPB has been that of expanding production while simultaneously dampening the enthusiasm of ill-prepared would-be producers. Before climbing aboard the DDT bandwagon, a prospective producer must now possess: (1) a source of raw materials, (2) suitable equipment and manufacturing facilities, (3) at least some "know-how."

Monthly production rate of DDT in this country totaled about 0.5 tons during the middle of 1943, increased to 150 tons by June of this year, at which time the nation's accumulative production did not exceed 600 tons. Then, rising sharply, the rate went up to the neighborhood of 400 tons by August, 750 tons during September. The WPB goal of 950-1,000 tons a month is expected to be reached by 1945. If used only as a delousing dust, this monthly goal would be sufficient to protect over 150,000,000 persons!

WHAT IT IS

DDT is a whitish, practically odorless crystalline powder having the formula $\text{CCl}_3\text{CH}(\text{C}_6\text{H}_4\text{Cl})_2$. Insoluble in water, it dissolves readily in alcohol, acetone, cyclohexanone, benzol, toluol, xylol and a wide range of petroleum oils and solvents. It is generally dissolved more easily in olefin and cyclic hydrocarbons than in the paraffins. As an insecticidal material, DDT is outstanding for its low volatility and stability.

DDT is moderately toxic when taken by mouth in small amounts by warm-blooded animals; large dosages to experimental animals are cumulative. In dust form, DDT is not absorbed and is non-irritating to the skin. In solution it is definitely (but not violently) toxic, especially if the vehicle is readily absorbed by the skin. This whole question of toxicity still needs much more investigation.

With the exception of very small quantities released for experimental purposes, the entire production is being channeled into direct military uses. It is unlikely that any DDT will become available for civilian use this year.

DOUBLE DELIRIUM TREMENS

Slow knockdown, sure kill: this is the outstanding characteristic of DDT toward most insects. Effects usually follow a definite pattern. Nerve centers are attacked, resulting in spasmodic activity sometimes referred to as "Gesarol jitters." Paralysis usually begins in the rear extremities and legs but progresses until complete paralysis and death result. Since

it lacks quick knockdown, DDT will complement rather than completely replace pyrethrum and the thiocyanates in household spray compositions.

Flies, for example, are provided with very delicate receptors on the tips of their legs through which DDT attacks the nervous system. A contact time of only 30 sec. and the slow paralysis mechanism is initiated. Although the victim may live as long as 24 hr. there is no escape from death. With a contact time of 10 min., death comes within a few hours.

With some insects, DDT seems to paralyze the nerves of the mandibles and digestive tracts so that the victims actually die of starvation. It is interesting that of 3,000 synthetic insecticides tested, only sodium fluoride and DDT act as both contact and stomach poisons.

Apparently DDT has no repellent effect on most insects. Entomologists like this, since repelled insects simply go away and multiply elsewhere. DDT compositions have little or no ovicidal value.

Two factors other than its possible toxic effects may tend to inhibit large-scale application of DDT in agriculture; toxicity to beneficial insects and selectivity of action. It is, for instance, deadly both as a stomach poison and as a contact agent to the honey bee, necessary for pollination of many plants. When used to control the Oriental fruit moth it also destroys beneficial insects that are parasitic to the moth. DDT is toxic to the codling moth but has no effect on the red spider, both injurious to apple trees. It would therefore be necessary to develop a supplementary control for the spider, now a minor pest, to prevent it from developing into a major nuisance.

One outstanding advantage of DDT is that it causes little or no foliage damage to most plants. Yet before it can be generally recommended for use against agricultural insects, much more extensive testing of DDT compositions must be made. Major points that need clearing up include: (1) Extent of injury to specific plants under a wide range of conditions; (2) danger to live stock, wild animals, birds and beneficial insects; (3) determining if small amounts eaten on vegetables and fruit will accumulate in man to the point of eventual serious poisoning; (4) mixtures, spreaders, stickers and diluents best suited for DDT compositions; (5) best methods of application; (6) relative efficiency-cost ratio of DDT as compared with other insecticides for each insect and crop.

ANOTHER PAUL BUNYAN

The startling effectiveness of DDT, coupled with the dramatic circumstances under which it appeared on the public scene, have created unprecedented interest in an insecticide. Tales of its exploits have spread from coast to coast and south of the Rio Grande.

Efforts at secrecy only served to confuse fact with fancy and to encourage the popular imagination to run amok. As a source of tall tales, DDT quickly became a Paul Bunyan among insecticides. Within a remarkably short time these tales filtered down and found credence with the average housewife, farmer, orchardist, cattleman, mosquito victim, keeper of mangy dogs and mitey chickens. Unlike Paul's pranks, fortunately, most stories on DDT usually contain elements of truth.

Those interested in tests with DDT on various insects should consult the February, 1944, issue of the *Journal of Economic Entomology*, to date the most complete source of information.

Good results have been obtained in controlling the Oriental fruit moth with DDT spray, fruit injury being reduced from 60 to 90 percent as compared to unsprayed trees. Preliminary tests show it to be one of the most effective agents known against the gypsy moth, which defoliates and kills trees in large areas of New England. Tests in Colorado establish its effectiveness in combating the spruce budworm, which vies with fire as worst enemy of American forests.

A dust containing as little as one percent DDT has repeatedly given good protection against the Colorado potato beetle. The Swiss reported this as early as 1941. A dust containing 20 percent DDT used at the rate of 2 lb. per 100 gal. of water has given in certain tests better results against the codling moth than lead arsenate used at the rate of 3 lb. per 100 gal. of water.

In short, DDT compositions show promise in combating such destructive agricultural and forest insects as the Oriental fruit moth, California red scale, Colorado potato beetle, corn leaf hopper, cabbage worm, Southern army worm, Japanese beetle, codling moth, European corn borer, corn earworm, gypsy moth, spruce budworm, white-fringed beetle and tomato fruitworm.

Unfortunately, DDT will not faze some agricultural pests. So far it has not shown particular promise against certain plant lice, the Mexican bean beetle, red spider, cotton boll weevil, grasshoppers and a few other insects.

HOUSEHOLD FRIEND

It has been against the ordinary household and barnyard pests that DDT has to date proven most effective. It is, for instance, more toxic to roaches than sodium fluoride, derris or pyrethrum, dramatically effective against house and stable flies, mosquitos, bedbugs, human lice of all types, ticks, chiggers, ants, animal fleas and carpet beetle larvae. The stuff even shows some value as a repellent against termites.

DDT is particularly effective against the fly. In one test, two applications

of a DDT spray on the inside walls of a barn kept it free of flies all summer despite the presence of cows in the barn and a fly-breeding manure heap just outside the door. If the concentration of the spray is high enough, leaving a visible deposit on the surface, the period of efficiency extends over four months or longer. According to one report (unconfirmed), DDT is so deadly to flies that it often kills those messing around their friends already poisoned by it.

Two infested manure piles were sprayed with 0.25 percent DDT and two with 0.1 percent DDT, then immediately caged alone with a check pile. Over a period of 18 days no flies emerged from the piles treated with the 0.25 percent spray, two flies came from the other sprayed piles, while 940 flies emerged from the check.

Dog fleas have been successfully controlled for over six months by a single application of a 5 percent dust, in spite of brushing and exposure to reinfestation. Washing would probably shorten the effective life of the DDT.

A 5 percent solution of DDT in kerosene is extremely effective against bedbugs. One such application has kept a bed 100 percent free of bugs 300 days.

POSTWAR-WISE

DDT is undoubtedly the hottest find in the insecticidal field since the turn of the twenties. Postwar prospects are promising although much more data are needed before it can be recommended for general use. Long-range prospects fall into three categories: (1) in medicine and sanitation as a control against disease-bearing insects; (2) in agriculture as a control against certain crop-destroying pests; (3) in research as a prod toward development of other synthetic insecticidal agents.

To millions of people all over the earth there could be no greater boon than freedom from the disease-bearing insects that have destroyed civilizations and plagued mankind from time immemorial. Potentialities of DDT for control of malaria, typhus, yellow fever, dysentery and other insect-borne diseases are enormous if one considers the annual toll these diseases take

Table II—Approximate Solubilities of DDT*

Solvent	Solubility
Benzene	106
Butyl alcohol, tertiary	4
Butyl alcohol, normal	8
Chloroform	96
Cyclohexanol	8
Cyclohexanone	100
Ethyl alcohol, absolute	4
Ethyl acetate	68
Ethyl ether	45
Kerosene	11
Orchard and spray oil	5
Paraffin, liquid	4
Petroleum ether (40-60 deg. C.)	6
Tetrachlorethane	56
Tetrahydronaphthalene	52
Toluene	48

* From *Chemical Age*, Sept. 9, 1944, p. 246.
† Grams per 100 g. of solvent as measured at ordinary temperatures.

CONTINUOUS PRODUCTION OF CHLORAL

1. Direct chlorination of alcohol in the presence of ferric chloride catalyst to form chloral alcoholate.
2. Liberation of chloral from chloral alcoholate by water dilution and by sulphuric acid acidulation treatment.
3. Separation by fractionation of chloral from side-products formed during the chlorination and acidulation steps.
4. Recovery of byproduct hydrogen chloride and excess chlorine as hydrochloric acid and as sodium hypochlorite.

in such places as India, China, Africa, Latin America, the Tropics and even in our own South.

Destruction of farm crops by over 6,000 kinds of insects costs the agricultural industry of the United States some two billion dollars annually, undoing the hard work of about a million farmers. Properly used, DDT might conceivably bring about a near-revolution in methods of controlling household and agricultural insects in this country.

Extent to which DDT will be used in agriculture may depend largely upon its

cost-effectiveness ratio with other materials. Costs are currently reported to range from \$0.85-1.60 per lb. This should drop considerably; estimates on postwar selling prices range from \$0.50-0.75 per lb. Obviously the lower figure would greatly stimulate usage and may be attained through processing improvements and postwar competition.

Rough estimates on annual requirements during the early postwar years range from 15,000-30,000 tons, with emphasis on a higher figure if applied cost is competitive with most other insecticidal materials.

Brothman Continuous Process for DDT Production

STIMULATED by the sudden demand for DDT, considerable study has naturally been given to methods of improving the manufacturing process. However, this is chiefly batch-wise and basically the same as that used by Zeidler in 1874 wherein chloral hydrate and chlorobenzol were reacted in the presence of sulphuric acid as the condensing agent. Purification of the reactant mass is still one of the chief engineering problems encountered in the process.

Back in 1943, A. Brothman and E. Z. Barish, now of A. Brothman & Associates, New York, specialists in continuous proc-

essing engineering, realized that converting the DDT process to a continuous production basis would speed up output for the armed services as well as lower manufacturing costs and thus become an important factor in postwar competition.

Accordingly, these engineers made a thorough mathematical and theoretical analysis of the Zeidler method. Optimum conditions thus theoretically determined were confirmed experimentally on a laboratory basis. Continuous methods for manufacturing and purifying both chloral raw material and DDT were demonstrated in pilot plant operations this year. Fur-

ther engineering work made in collaboration with Graver Tank & Mfg. Co., Inc., E. Chicago, Ind., confirmed the sound economics of the Brothman continuous processes.* Engineering work is being continued and at least one large commercial plant will soon be producing chloral and DDT by the Brothman methods.

Advantages of such continuous type production are obvious: (1) Maximum uniformity in quality of end products; (2) maximum efficiency and uniformity of performance in all units; (3) minimum general labor-power cost per unit of production; (4) minimum dependence upon technical control personnel and hence a minimum cost due to control work. The continuous throughput of materials is automatically controlled by instrumentation, which provides maximum control over the products and operations with a minimum of labor.

CAPACITY AND COST

Essential features of the processes are shown in the accompanying flowsheets. The following description is based on data from pilot plant operations and is for a commercial plant using the Brothman continuous process designed to produce 200,000 lb. monthly of DDT material meeting the Army specification of a minimum setting point of 88 deg. C. Such a production schedule for DDT would require a chloral output of 87,300 lb. monthly. These outputs are on the basis of a 25-day month and a 24-hr. day.

Total estimated cost of chloral and DDT plants with these capacities is placed at \$211,000. Of this, about \$27,000 represents processing equipment for the chloral unit and \$28,000 for such equipment in the DDT unit.

Materials used in the production of chloral are: 95 percent alcohol, chlorine gas, 36 percent hydrochloric acid, iron, and 96 percent sulphuric acid. Alcohol, sulphuric, and muriatic acid storages are constructed of mild steel plate. The muriatic storage has a 0.375-in. Pyroflex back-up layer covered by a single course of 4.5-in. chemical brick. It would contain 50 sq. ft. of Karbate heat exchange surface as internal coils so as to maintain the acid at constant temperature and strength and back pressure on the hydrogen chloride absorber at a fixed value. The catalyst mixing tank would consist of a 75-gal. chemical stoneware vessel with a 0.5-hp. air-lift agitator unit of Karbate gas-diffuser elements.

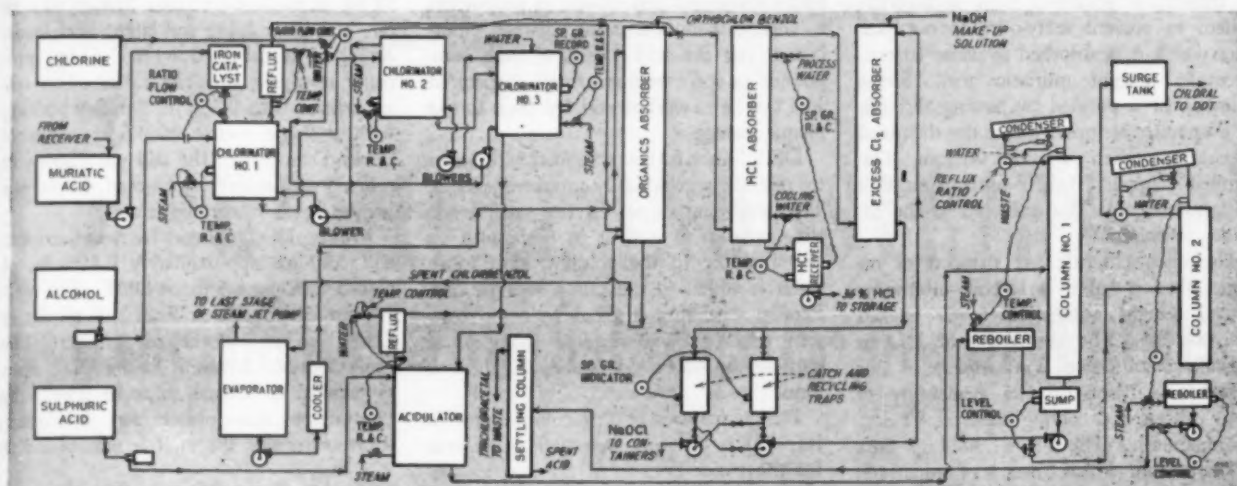
CHLORAL PRODUCTION

Chlorination of alcohol to chloral alcoholate is catalyzed by iron dissolved in

* Novel features of these processes are fully covered in patent applications now on file with the U.S. Patent Office.

CONTINUOUS PRODUCTION OF DDT

1. Reaction of chloral and chlorobenzol with oleum to form dichloro-diphenyl-trichlorethane, its isomers and polymers.
2. Separation and neutralization of the dissolved DDT from oleum by settling, then by water and alkaline washings.
3. Vacuum distillation and recovery of chlorobenzol solvent, followed by air stripping of residual chlorobenzol from DDT.
4. Cooling and solidification of DDT, followed by pulverizing, blending with extenders and final packaging.



Chloral, a principal raw material for DDT, will be made by this continuous process developed by Brothman

hydrochloric acid. The first two reactors are designed for a working capacity of 1,395 gal., the last for 2,140 gal. Alcohol is fed continuously to the chlorinator bank. Chlorination is controlled in the first two vessels to yield a mass of a prescribed specific gravity. Water is added to the last unit to liberate alcohol from chloral alcoholate.

Reactors are arranged for countercurrent flow of chlorine through the bank. Agitation is attained by the use of gas-lift and draft-tube assemblies. Gas for the third reactor is drawn from a recycle line off the vapor section of the first reactor. The second reactor draws its gas-lift fluid from the third reactor, the first vessel from the second. Free chlorine is fed through automatic feed control vaporizing equipment to the last reactor. The bank is designed to give 60 percent yield of chloral from alcohol, most of the loss going into various other chlorinated derivatives.

The chlorinators are vertical tanks of mild steel plate lined in the same manner as the muriatic storage. All have chemical stoneware open-top draft tubes with Karbate gas-diffuser elements sufficient to provide 5 hp. gas-lift agitation in the first two units and 7.5 hp. in the third. Temperature control during chlorination is fur-

nished by passing steam through internal coils.

Chlorinated "oil" from the last reactor has a specific gravity of 1.5 and contains free chloral, chloral alcoholate, excess alcohol, ethylidene dichloride, ethylene dichloride, ethyl chloride, trichloroacetal and resinous matter. In the acidulator this "oil" is mixed with 96 percent sulphuric acid which "degenerates" residual alcohol and completes the freeing of chloral from chloral alcoholate.

Acidulator feed consists of chlorinated "oil" and sulphuric acid. An important feature in this operation is the retention of 95 percent of the influent stream for at least one hour.

This acidulator is an 800-gal. mild steel plate tank lined with chemical brick in the same manner as the chlorinators. Chemical stoneware open-top draft tubes are provided with gas-diffuser elements to furnish 3 hp. of gas-lift agitation. The unit is also provided with an internal heat exchange.

CHLORAL PURIFICATION

Acidulated "oil" is sent to fractionating columns to remove side-reaction impurities. The first column separates chloral from high-boiling constituents such as

ethylidene dichloride, ethylene dichloride, ethyl chloride and ethyl ether, the latter formed from sulphuric acid and alcohol. A maximum total mole fraction of 0.006 of "high boilers" is left in the bottoms, accomplished by using a high reflux ratio. The condensed "low boilers" can be sent to waste or mixed with a fuel gas stream, burnt, and absorbed in a tail-gas scrubber of special design.

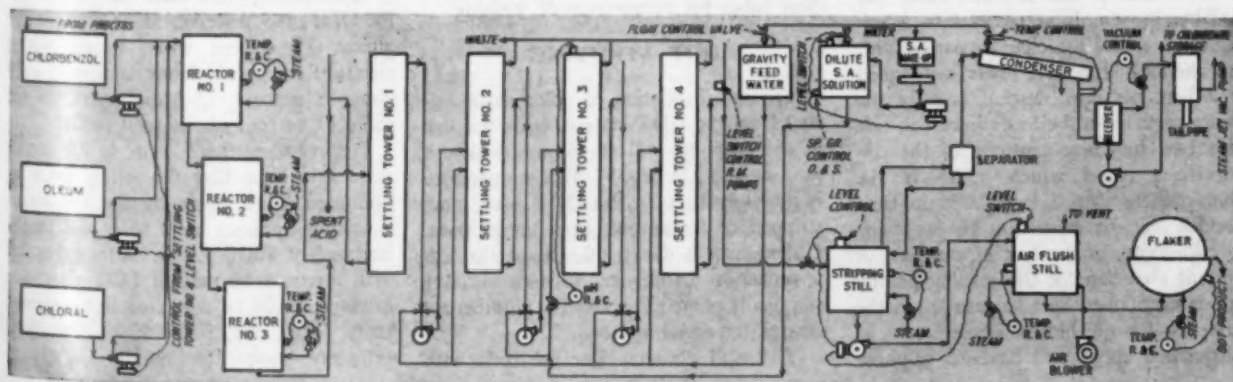
This fractionating column consists of chemical stoneware sections and is packed with 0.5-in. Berl saddles.

Chloral mixed with trichloroacetal and resinous material is fed to the second fractionating column, which uses a comparatively low reflux ratio, in which there is virtually a quantitative separation of chloral. Spent acid containing trichloroacetal is discharged from the bottom of the tower into a small settling column where the acid settles out and can be fortified for reuse. Chloral, coming off the top of the fractionating column, is sent to a surge tank located between the chloral and the DDT units.

This fractionator is similar in design to that previously described. The still pot is a 75-gal. vessel containing some 30 sq. ft. of heat exchange surface.

Hydrogen chloride, produced during chlorination in a theoretical 5:1 mole ratio

By continuous processing and control instrumentation, the Brothman process for DDT achieves maximum economy



to chloral, is scrubbed with orthochlorobenzol to prevent carry-over of organics, after which it is absorbed in water to produce 36 percent muriatic acid. Spent chlorobenzol is purified by passing through an evaporator stripper, where the dissolved organics are taken off under vacuum. The purified stripper is then sent through a refrigerated cooler and recycled to the organics scrubber.

Hydrogen chloride gas stripped of organics then is fed to a 10-coil, internally-cooled Knight absorption tower packed with saddles. The absorption of HCl is virtually quantitative. Performance of this absorber is based on the availability of both process and cooling water at 80 deg. F. maximum. The 75-gal. hold-up tank at the bottom of this tower is of stoneware. Acid is pumped to storage or to the catalyst tank for make-up purposes.

Any excess chlorine gas that might escape the hydrogen chloride absorber will be neutralized in a tail-gas scrubber with 10 percent caustic soda solution. This is recirculated until the desired concentration of sodium hypochlorite is reached.

DDT PRODUCTION

Raw materials for DDT include chlorobenzol, oleum and chloral. Storages for these are similar in design to that of the alcohol storage of the chloral plant.

Chloral, oleum and an appreciable excess of chlorobenzol are fed into the first reactor by metering pumps. This vessel has a working capacity of 2,200 gal. A condensation reaction takes place to produce dichlorodiphenyltrichlorethane as well as its isomers and polymers.

Condensation vessels are hooked in series and have equal capacities. All are provided with turbine mixer agitation assemblies and with internal coils to maintain the reaction temperature. Overall yield, based upon chloral, is 95 percent of a DDT-mixture having a minimum setting point of 88 deg. C. The insecticidal value of the DDT isomers and polymers seems still to be a moot point.

Reactors are lined with 0.375-in. Pyroflex back-up and a single course of 4.5-in. chemical brick and provided with a closed-top side-port draft tube.

At the end of the reaction time, the DDT-bearing emulsion passes into a settling tower where the oleum separates out. This chemical stoneware tower is designed for a 1-in. per min. descent rate for the heavier particles in the feed. Since this rate holds best for those particles of the discontinuous phase which approach the mean particle size, a large hold-up time provides efficient separation by encouraging coalescence of the smaller particles. A constant elevation for the settling neutral zone is maintained by a balance leg in the outlet leg for the heavier phase.

Separated spent acid contains sulpho-

ated chlorobenzol and chloral in proportion to their distribution ratios between chlorobenzol and the acid. Losses of such compounds in spent acid are small. Separated acid can be re-worked and fed back to the oleum storage.

DDT liquor is then scrubbed with water to remove mechanically-entrained oleum. The scrubbing occurs in the second settling column as well as in the pump on the inlet leg to the column, since wash water is added to the pump suction side. Parallel scrubbing is aided by countercurrent washing of descending heavy phase particles by water fed directly to the column.

Design features of this column provide for: (1) a 1-in. per min. rate of descent for the major portion of the heavier particles, and (2) a hold-up time of 120 min. for the throughput in order to obtain maximum coalescence and separation. A constant elevation for the neutral zone is maintained as in the oleum settling tower.

The third column, together with the pump on the column feed leg, provides for final neutralization of entrained acid. To do this, soda ash solution is fed to the pump suction side for parallel washing and directly to the tower for countercurrent washing. About 2 lb. of soda ash are thus consumed for every 98 lb. of DDT.

Design characteristics for this column are similar to those for the second settling column except that provisions are made for a hold-up time of 3 hr. and a descent rate of 0.5 in. per min. for the heavy phase particles.

Soda ash solution is prepared by diluting a 25 percent master solution made batchwise in a 110-gal. dissolver, provided with two 9-in. turbine mixers of 750 r.p.m. The sump lung beneath the dissolver permits a 2-hr. dissolving period for each batch. In all instances column temperatures are sufficiently high to prevent crystallization of the DDT.

Neutralized DDT-containing chlorobenzol is given a final water wash in the fourth settling tower under similar conditions as in the second column. Water for parallel scrubbing is fed to the pump and for countercurrent washing directly to the column. The last three settlers are chemical stoneware columns provided with diffuser tubes for countercurrent washing.

DDT STRIPPING

Vacuum distillation of chlorobenzol solvent from the DDT material is carried out in the stripping still at 35 mm. absolute pressure and 221 deg. F. This temperature is necessary to keep the DDT mass, now stripped of its solvent, in a liquid state. Chlorobenzol is drawn off, passed through a separator, condenser, vacuum receiver and finally pumped back to the chlorobenzol storage for recycling.

This still contains internal coils with

35 sq. ft. of heat-exchange surface to take care of both sensible and latent heat loads. Agitation is provided by a 1.5 hp. propeller revolving at 1,125 r.p.m. The vessel is lined with 0.375-in. Pyroflex backing with a single course of 4.5-in. chemical brick. Diameter of the still was chosen to provide an evaporation rate of 40 lb. per hr. per sq. ft. of surface area.

Molten DDT effluent from the stripper still contains approximately 0.195 lb. of chlorobenzol per 5.5 lb. of DDT. The melt is pumped into an air flush still similar in design to the chlorobenzol stripper. The mole fraction of solvent in the DDT mass is reduced to a final value of 0.0175 by continuous atmospheric air distillation. Temperature of the melt is maintained at 221 deg. F.

About 10.2 lb. per hr. of chlorobenzol are removed from the molten DDT and vented. To do this requires approximately 100 cu. ft. per min. of air. Only about 0.04 percent loss of DDT occurs during the stripping and air flushing operations.

Latent heat load in the air flush still is 29,000 B.t.u. per hr. This is carried, in addition to radiation and convection losses, by internal coils. Propeller-type agitation is used to provide optimum heat transfer.

Molten DDT now free of chlorobenzol solvent is run to a flaker, consisting of a steam-heated feed trough through which a chilled drum rotates at 4.5 r.p.m. The DDT melt is chilled to 186 deg. F., solidifies on the drum and is flaked off.

Both drum and feed trough are fabricated from 10 percent stainless-clad steel. The refrigerator unit, which serves the flaker and the orthochlorobenzol cooler in the chloral plant, is a 5-hp., Freon-12 type that provides a suction temperature of -10 deg. F.

Chip DDT is pulverized to -150 mesh size, after which it is packaged in concentrated form or is blended with pyrophyllite talc or other inert extenders in conventional type equipment.

COST OF MANUFACTURE

Basic economies of the Brothman continuous processes show up best in estimated manufacturing cost figures for the final product. Of the estimated net cost of considerably less than \$0.30 per lb. for DDT, raw materials alone account for almost 75 percent while steam, water, electrical energy and labor amount to only about 8 percent. Overhead accounts for some 17 percent of the total cost.

Postwar-wise, there seem to be sound reasons to hope that the selling price of undiluted DDT made by the Brothman continuous process could be in the neighborhood of \$0.50 per lb. After extension with inerts, a 10 percent DDT dust, for instance, could be marketed in household units for about \$0.20-0.30, depending primarily upon the middle-man's cut.

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CHEMICAL INDUSTRIES

As the Basic Growth Industry of the Future

Truly synthetic by nature and characterized by endless change, the chemical industry, prodded by research and supported by engineering, may well become the universal basic industry of the future. And pulled along in the wake of its progress will be the family of chemical process industries, some members of which already are losing their former identity and individuality. Some of the characteristics of the industry that lend support to these statements are outlined in this article.—Editors

CHEMISTRY is the science of change and the chemical process industries are the industries of progress. It is this ability to carry out a complete transmutation of something old and common to something new and unknown which has been the fascination of the science of chemistry from the days of the alchemists to the present time.

This fascination of the unknown is a guarantee of the continued interest, growth and expansion of chemical industry as long as man retains a bump of curiosity or, as we may say, at least to the end of his geologic era.

Thus the chemical industry, a model "growth" industry, holds within itself the means by which growth can be perpetuated: continuous research followed by commercial development of new products and processes originating from the research laboratories.

This article is an abstract by the editors of *Chem. & Met.*, of the lecture given by the authors before the Southwestern Chamber of Commerce Institute for Commercial Organization Executives, Dallas, Texas, July 28, 1944.

Most industries utilize chemicals in the processing of goods into finished products and in many cases the processes are partly chemical in nature, whereas certain industries produce some chemicals incidental to other operations. These industries are generally classified as the chemical process industries, among which are some of the leading consumers of chemicals, as distinct from the chemical industries which produce, through chemical reactions, individual chemicals for their own value. The separation is generally shown as in Table I.

According to this classification, products of the chemical industry, in the restricted sense, accounted for 2 percent of the total value of all manufactured products in the United States in 1937 and 2.1 percent in 1939. On the other hand, the chemical process industries accounted for 20-50 percent of the value of manufactured goods, depending on the scope included.

WARS AND GROWTH

During and after World War I the American chemical industry, then largely inorganic, went through a typical growth curve. Although it fluctuated somewhat after the war, it appeared to be leveling off within a fairly definite range of total value of products.

During World War II, the organic chemicals industry, which was a wholly negligible factor in World War I, is going through a similar period of rapid growth. This new organic chemicals industry, coupled with unusual demands for certain inorganic chemicals such as ammonia and nitric acid for explosives, is developing a second S in the growth curve as a continuance of the first one. The older inorganic part of the industry appeared to be leveling off at about 800 million dollars per year for the value of its products. To be conservative, we must assume that after the war it may come back to somewhat near that same figure.

Just how far the organic chemicals group will grow is impossible to predict at the present time. However, it appears that

the organic business will be at least as large, eventually, as the inorganic business, thus making the total chemical business in the United States about double what it was during the twenties, after which it had already quadrupled during the 'teens.

The figures which are the basis for the accompanying curves include all the chemical industry products enumerated in Table I except drugs and pharmaceuticals, where figures for different years are not comparable. The value of products for drugs and pharmaceuticals was about 350 million dollars in 1937 and 365 million dollars in 1939.

The organic chemicals industry has taken under its wing almost completely that infant giant, the plastics industry, for which it has always supplied the raw materials and much of the research development. The development of such an industry as this is, of course, part of the growth curve now being experienced. Similar developments of new industries in the future might underlie the extension of the present chemical industrial growth curve or even start a new one.

For example, the chemical industry has developed many new fibers within the last few years. It is not impossible to imagine that at some future date the textile industry may gradually become integrated with the chemicals industry which produces and knows how to process the synthetic fibers.

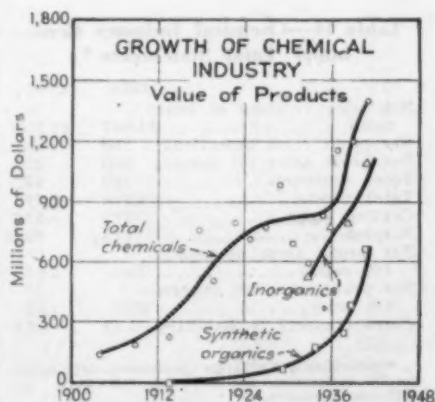


Table I—Chemical and Chemical Process Industries

Chemical Industries
Heavy chemicals
Fine chemicals
Synthetic organic chemicals, including dyes and intermediates
Plastics
Drugs and pharmaceuticals, not including proprietary preparations
Explosives
Compressed and liquefied gases
Insecticides and fungicides
Industrial alcohol
Solvents
Wood distillation products
Chemical Process Industries
Fertilizers
Iron and steel
Non-ferrous metals
Glass and ceramics
Rubber
Petroleum
Rayon
Sugar
Food
Leather
Paint, varnish and lacquers
Textiles
Pulp and paper

Best industry-total statistics are probably those furnished by the Securities and Exchange Commission in its "Survey of American Listed Corporations." These statistics are based on the annual corporation reports, using a prescribed uniform accounting system, which have been required by law since 1934 of every corporation whose stocks are listed on the New York Stock Exchange. This is the first time that such groups of corporations have been required to report their statistics in a comparable manner. The standardized bookkeeping thus introduced has caused some fairly large revisions, especially in the assets column. Also, some data such as volume of sales, is now included which had previously been withheld by some chemical companies, many of which have been quite secretive.

These statistics suffer necessarily by not including corporations whose stocks are not listed. The 38 companies which are included in the totals for 1939 and 1941 produced 87.5 percent of the total value of chemical production given by the Manufacturing Chemists' Association in 1939.

Financial characteristics of the chemical industry of the present time are summarized in the combined totals given in

Table II—Chemical Industry Combined Total Statements *

	1939	1941
Net sales (volume of business)	\$1,047	\$1,755
Net profit from operations	189	431
Net profit after all charges	200	223
Total dividends	160	172
Total assets	1,946	2,372
Capital stock	919	915
Surplus	678	793
Net profit from operations (% sales)	18.0	24.5
Net profit after all charges (% sales)	19.1	12.7
Current assets to liabilities	5.49	2.29

* Securities & Exchange Commission data based on 38 companies, not including fertilizers. As millions of dollars.

Table II. These financial characteristics make a favorable showing for the industry in comparison with other American industries over the same period. The chemical industry has shown an exceptional growth of assets, balanced by capitalization, and equalled by sales volume over the last 20 years.

Net earnings have been uniformly high as compared with most industries, and this has been reflected in the accumulation of a substantial surplus, the payment of regular dividends, and the reinvestment of large amounts in the industry in the form of new plants for old products, and research and development of new processes and new products.

Maintenance and depreciation expenses are high for the chemical industry, but cost of sales, including cost of manufacture, is lower than for most industries, being about 51-54 percent of sales. This allows a favorable net profit all the way down the profit-and-loss statement. The net profit from operations, 18 percent in 1939, was one of the highest reported for any industry reported by the Securities and Exchange Commission, being equalled only by the non-ferrous metals (18.7) and rayon industries (18.5).

The new organic chemicals business appears to be more profitable than the older business in inorganic chemicals. This should be expected because the newer organic chemicals are still being commercially prepared under patent protection for the most part, whereas the large-volume inorganic chemicals are in many cases being manufactured under processes which are patent-free, but under conditions where the large volume production by one or a few companies is the most economical. There are no direct figures on this because many large chemical companies are engaged in both fields simultaneously.

RESEARCH PAYS

Included in the costs of production of the chemical industry is one very important item upon which the industry as a whole has based a great deal of its expansion: Research. In 1937 and 1938, the chemical industry employed over 300 research workers per 10,000 wage earners, or about a fifth of all the research workers in the country. The expense of chemical research in 1938 amounted to 3.3 percent of sales (22 companies) or more than 18 percent of net profits from operations. The organic chemicals industry reported a higher figure, 4.3 percent of sales for research in the same year, and the figure was 5.0 percent in 1933 when sales were smaller. American industry as a whole is estimated to have spent about 0.2 percent of sales for research in 1938.

This emphasis on research is important in the history of the industry. It has meant expansion into new products and

markets rather than the simple expansion of the production and sales of one or a few items. Thus, each of the large chemical companies has diversified into many new fields, thereby becoming more resistant to pressure and depressions while at the same time opening the road to the development of still other new chemical products.

Another corollary of this method of expansion is the time, effort and expense which is necessary for the commercial development of most chemical processes. Experience has shown that usually a long, expensive period of research and semi-commercial production is necessary to perfect a process. Six years from discovery to the first commercial shipment is often quoted as an average in the industry, but many processes have taken much longer than that. However, once a use and process are established, the experience has been that usually the industry quickly becomes fairly stable.

Approximately a third of all chemical sales are to industrial consumers as compared to 27.4 percent for industry as a whole. An unusually large percentage, 31.3 percent, goes into the chemical industries' own wholesale branches as compared to 21 percent for all industry groups. The great majority of chemicals disappear into the processing of finished goods, so that the ultimate consumer sees only a finished product and seldom sees the chemicals which were used in its manufacture. As a matter of fact, the chemical manufacturers are among their own best customers.

There has been a gradual tendency in recent years for some chemical companies to extend towards the production of ready processed or consumers goods. This has been especially true in the fields of plastics and synthetic fibers, but it has been felt also in the fields of paints, varnishes and lacquers, veterinary medicines, insecticides and fumigants, and others. In contrast to this trend, there is also a tendency for some processing companies to develop chemical manufacturing on their own.

Most chemicals, as stated before, are consumed by the chemical process industries. Some trends in consumption by these industries are shown in Table IV. If the percentage increases for 1935-41 are rearranged in their order of magnitudes, we can see very easily which industries have been the fastest growing users of chemicals. The plastics industry easily tops the list.

Textiles have also become related to the plastics industry and to the chemical industry, since the synthetic materials which are spun into fibers are generally plastics and can be used in other forms than that of fibers. In addition, synthetic chemical detergents, wetting agents, coatings, agents for mothproofing, waterproofing and crease-resisting fibers have increased tremendously in recent years.

The rubber industry itself may step right into one of the first places in this table if the various synthetic rubbers now in production hold their markets. The Government has invested approximately \$700,000,000 in plants and equipment for the production of synthetic rubbers and of the chemicals from which they are produced. This is equal to approximately 70 percent of the total private investment in the chemical industry up to the time of the war. The industry so produced and now operating is typically a chemical industry, produced in the emergency at a faster rate than any chemical industry ever before. That it could be done at all is a tribute to the industrial chemists and chemical engineers of this country. The future of this business will depend primarily on the quality and price of the products in the postwar period.

At the other end of the list are the leather, glass, petroleum, paint and varnish, industrial explosives, and fertilizer industries. It should not be inferred that these might not become profitable chemical outlets. The opposite is true, and the development of some new outlet or use for chemicals in these fields offers great possibilities. The very fact that leather is at the bottom of the list might indicate a profitable field in which to look for increases in chemical consumption.

GENTLEMANLY COMPETITION

Competition within the chemical industry has been keen, but for the most part it has been remarkably orderly, one can truthfully say, gentlemanly. Competition is really technical competition or competition between different processes or between products competing for the same end use. Hardly ever is the competition between two or more producers of the same material by the same process.

Competition between technical, scientific and engineering skill is as keen as lightning flashes, but pressure-selling, price-cutting and labor-sweating are not generally practiced in the industry. Selling methods are apt to be on the conservative side, and sales are based usually on the quality of the product for the specific use intended rather than on price alone.

Expansion has come most rapidly during a war period; the inorganic chemical industry during World War I, the organic chemical industry during World War II. This may be due to the difficulties and the long and costly development period usually required in peace times for the development of a production process and of a sales market for a new product. During war periods demands have become insistent and developments have been rushed through regardless of cost, sometimes on the basis of intelligent guesses in the absence of complete scientific data on some phase of a process.

Table IV—Consumption of Chemicals by Industries

Industry	1935 Base Year	1941	Percent Growth 1935-1941	Growth Position
Fertilizer	19.47	31.49	61.8	7
Pulp and paper	12.39	21.92	77.0	6
Glass	10.58	15.03	42.1	12
Petroleum	10.51	15.20	44.7	11
Paint, varnish & lacquer	10.35	15.03	45.2	10
Iron and steel	7.20	12.88	78.8	5
Rayon	6.29	12.87	104.5	2
Textiles	6.11	11.06	97.3	3
Coal products	5.74	9.28	61.7	8
Leather	3.95	4.88	23.5	13
Explosive (industrial)	3.62	5.54	53.0	9
Rubber	2.17	3.91	80.2	4
Plastics	1.62	3.71	129.0	1
	100.00	162.80	62.8	

Chemical businesses once established have tended, for the most part, to be stable and profitable and individual business enterprises, particularly those which have strongly supported research activities and those which have not hesitated to diversify their products, have shown unusual abilities to grow and expand.

In this country, the inorganic and heavy chemicals industry is an older, larger volume, and probably lower profit industry than the younger, rapidly expanding organic chemicals industry. Although there will undoubtedly be some exceptions, it can generally be said that improvements and discoveries in the technology of inorganic chemicals should be expected to come slower as time passes.

The synthetic organic chemicals industry, on the other hand, was born in this country about 25 years ago and it is even now in the process of a breathtaking ex-

pansion. Of the various source materials for organic chemicals, it appears unlikely that there will ever be a better source than petroleum. The next 10-20 years may well be spoken of as the "Petroleum Era." However, the utilization of petroleum and coal for chemicals will always be negligible with respect to their utilization for power. If petroleum sources are used and disappear, then similar products may be made from coal and finally from carbohydrates such as cellulose and sugars from plants.

There is almost no industry for which scientists have not found some chemical the use of which will improve an old product or help to produce a new one. Since chemicals are primarily raw materials, the future chemical industry may not only be the basic industry that it is today but it may become the universal basic industry of our physical civilization, underlying all other industry.

Table III—Industry Statistics for 1939*

Number of Companies	Type of product	Total Assets**	Net Sales**	Current Assets to Liabilities, Percent	Net Profit from Operations, Percent
19	Non-ferrous metals and products (assets over \$20,000,000).....	\$253	\$1,080	4.84	18.7
5	Rayon yarn.....	115	69	5.20	18.5
38	Chemicals.....	1,946	1,047	5.49	18.0
14	Drugs and medicines.....	230	253	4.67	16.6
8	Cement.....	142	61	8.74	15.7
8	Toilet preparations and soap.....	247	342	4.81	15.3
10	Metal and glass containers.....	527	472	5.42	11.9
6	Biscuits and crackers.....	179	159	5.82	11.8
19	Building materials other than clay products and cement.....	405	335	5.50	11.6
13	Clay products.....	101	44	4.04	11.5
13	Grocery specialties and miscellaneous food products.....	379	418	5.37	10.8
6	Beet sugar.....	156	98	2.83	10.7
15	Floor coverings and miscellaneous textiles.....	174	168	5.46	10.3
15	Non-ferrous metals and products (assets under \$20,000,000).....	115	103	4.69	9.8
37	Oil refining.....	7,865	3,938	4.42	9.6
6	Distilled beverages.....	312	308	6.84	9.3
37	Paper and allied products.....	767	498	4.42	8.4
49	Steel (assets under \$100,000,000).....	560	428	3.88	8.3
15	Tires and other rubber products.....	736	779	4.78	8.0
10	Grain mill products.....	213	309	6.66	8.0
12	Steel (assets over \$100,000,000).....	4,114	4,255	4.77	7.8
11	Food canning and preserving.....	190	212	3.30	7.5
17	Apparel & related finished products.....	69	96	5.77	6.8
12	Hosiery.....	60	100	4.17	6.2
14	Shoes.....	181	239	7.04	6.1
9	Paints and varnishes.....	75	94	6.42	5.9
8	Bread and cake.....	138	192	3.53	5.3
11	Textile fabrics.....	233	266	2.91	4.7
5	Leather tanning.....	31	36	0.82	4.6
5	Vegetable oils.....	83	126	2.33	4.3
5	Fertilizers.....	107	67	10.92	2.4
6	Cane sugar refining.....	180	150	4.69	2.1
14	Meat packing and allied products..	849	2,249	4.62	1.9

* Securities and Exchange Commission data. ** As millions of dollars.

Characteristics and Applications of HYDRAULIC CONVEYORS

Hydraulic conveyors are well suited to a number of types of conveying applications, such as the handling of ashes from ash pit to dump, and the handling of coal under certain circumstances. Their power requirement is relatively high, but their operating characteristics often offset this undesirable factor. Like the pneumatic conveyor, previously described by the author, their power consumption can be predetermined with a fair degree of accuracy, as shown in the accompanying article.—*Editors*

TRANSPORT of bulk materials by flowing water has some important applications and frequently provides the best solution of the problem. The hydraulic conveyor functions much as does a flowing stream in nature. Light materials, leaves, twigs, etc., float on the surface. Heavier materials submerge and may roll along the bottom, unless the stream velocity is below the critical point where the material will stall and build up.

An application in industry, accepted by engineers as among the best, is for the disposal of ashes from large steam plants. The ashes may be flushed from the pits by a directional jet to a covered sluice, then the flow is maintained by booster jets. A closed connection between ash hoppers and sluice eliminates the dispersal of gas, vapor and dust. If the run of the sluice is direct and horizontal, booster jets are spaced 50 ft. or 60 ft. along the run. At 100 lb. pressure the nozzle velocity is about 7,000 ft. per minute so it is possible, by locating one booster jet at the up-turn of a closed duct, to give the stream of ashes and water an imparted velocity sufficient to continue the flow up an inclined path, as from a boiler house base-

ment to above ground level. If the layout does not permit direct sluicing the ashes are flushed to a sump and, with the addition of clean water to reduce the erosion of the pump parts, the solution is pumped to a disposal area or to an overhead dewatering and storage bin.

A jet nozzle discharging 175 g.p.m. will flush out the pit at a rate of 1 ton per minute. Sluicing nozzles providing 225 g.p.m. each will move the mixture of water and ash along the duct at that rate. Thus if the duct has a straight run of about 400 ft. with boosters 60 ft. apart, the total water requirement will be 1,750 g.p.m., calling for a pump of 2,000 g.p.m. delivery at 125 lb., and a 100-hp. motor. The ratio usually is 5 to 7 lb. of water per pound of ashes. If each ash pit has a capacity of about 5 tons it will require about 10 minutes to flush it out and start operations at the next.

If the ashes must be pumped out they are first flushed to a sump with a grid to catch the occasional clinker or fragment of firebrick too large for the pump to digest. This pump should preferably be protected against erosion by auxiliary clean water injection. It must have a capacity for the 175-g.p.m. jetting stream, plus the 225-g.p.m. sluicing to the sump, plus 500 g.p.m. of conditioning and injection water, or a total of 900 to 1,000 g. p. m. The head loss in the disposal pipe with a velocity therein of not less than 6 ft. per second will be about 3 ft. head per 100 ft. of pipe. If the disposal area is 400 ft. from the sump, the disposal motor will be 20 or 25 hp. Since interruption of service due to shutdown of this pump because of accident or repairs would stop the disposal of ashes, a stand-by pump usually is provided.

While the power requirement for a hydraulic system is several times that for a mechanical conveyor, power is a minor factor compared with dustless operation and elimination of danger to the men.

For the small plant, also, hydraulic disposal may be advantageous. At one plant with three boilers equipped with chain-grate stokers, a concrete trench 24 in. wide was provided, extending from

beneath the rear ends of the grates to a sump. It was found by trial that a flow of 100 ft. per minute sufficed to move the ash and clinkers to the sump, from which they are removed by a grab bucket. The water is recirculated with the addition of sufficient make-up to minimize erosion of the pump rotor, while surplus water drains to an adjacent pond. The proportion of ashes to water is low—about 6 percent by volume, but the percentage could be stepped up by increasing the rate of flow if desired.

For handling coal, also, the hydraulic conveyor has some unique applications and possibilities. Fig. 2 shows a simple and ingenious installation devised when priority for a reserve coal-storage conveyor could not be obtained. From some 6-in. leader pipe on hand, a duct was assembled leading out from the discharge of the coal elevator over the proposed reserve storage area. The ground slopes easily to a river, permitting drainage through the soil. As the capacity of the sluice with the water available was but half the handling rate of the elevator, an adjustable bypass controls the flow to it. The light-weight pipe line is easily shifted or extended as the coal piles up. A storage capacity of several hundred tons was thus provided at a cost of about \$100, or about 3 percent of the cost of a suitable mechanical system. The water used approximates 500 g.p.m. for a handling capacity of 10 tons per hour.

The hydraulic method is better suited to the formation of reserve ground storage than to bin or bunker storage since the water must be drained off before the coal is usable, and this draining sometimes is difficult to arrange for. Some installations inclose the reserve area by a dike. The water drains off by gravity as the top layer is reclaimed either by drag scraper or bulldozer. It is of course necessary to ascertain first whether there are any complications preventing this outflow. Severe winter conditions would be a serious handicap to submerged coal storage.

One simple and effective hydraulic conveyor installation is at an anthracite coal breaker where a battery of screen chutes

loads to cars. The empties are brought to the chutes and the screened coal passes over, while the undersizes must be re-screened and returned to the bins. A duct at ground level, with booster jets at intervals, floats the coal screenings to the boot of a slow-speed, perforated-bucket elevator. The coal drains as it is elevated. The surplus water with the proper amount of make-up may be recirculated.

Various types of de-waterers are available. Usually these are vibrating screens with the screen proper of wedge-section wire to minimize "blinding." Another screen has longitudinal high-carbon, cold-draw steel wires stretched tightly without cross wires.

A common application of water as a conveying medium is for transporting sand and gravel in dredging operations. If the material is to be delivered to a preparation plant the hydraulic method has a decided advantage in providing preliminary cleansing. Washing usually requires 2 to 6.5 cu. ft. of water per cubic foot of sand and gravel, while for conveying, the sand and gravel constitute only 10 or 12 percent of the volume of water. However clean water must be provided for rinsing.

In his excellent paper (I.C. 6875) E. R. Thoenen of the U. S. Bureau of Mines points out that the efficiency of the hydraulic system is not very pleasing. If we assume a mixture containing 12 percent of solids, a head of 25 ft., and a capacity of 100 tons per hour of sand weighing 110 lb. per cubic foot, then $(100 \times 2,000) / (60 \times 110) = 30.3$ cu. ft. of material per minute must be moved. At 12 percent this will require about 234 cu. ft. of water per minute. Assuming 40 percent voids

and allowing for water filling the voids, the volume of mixture will be 252 cu. ft. pumped per minute. The weight of mixture per minute is 30.3 cu. ft. of material at 110 lb.=3,333 lb. plus 234 cu. ft. of water at 62.5 lb.=14,625 lb., which totals 17,958 lb. The theoretical horsepower is $17,958 \times 2.5 / 33,000 = 13.6$ hp. The horsepower for lifting the sand alone is $30.3 \times 110 \times 25 / 33,000 = 2.5$ hp. We see that 80 percent of the required power is expended on the water. However, there may be other considerations which minimize the importance of the power requirement.

A single illustration will suffice. When the construction of the Alameda, Calif., airport was undertaken, the writer was faced with very considerable expense for several thousand yards of fill to bring the grade above the tide level of San Francisco bay. It so happened that a contractor was about to begin dredging the Oakland estuary on the opposite side of the Central Pacific tracks under a contract that required him to dispose of the dredged material so as not to block the channel. A mutually profitable arrangement was concluded by which he was permitted to extend his suction dredge discharge line across the airport site. By occasionally shifting the position of the discharge and levelling by bulldozer the airfield was formed at practically no cost.

The hydraulic conveyor differs altogether from mechanical conveyors. It does resemble the pneumatic conveyor in principle, and the power requirements and handling capacity for a specified material can be pre-determined with about the same degree of inaccuracy.

Assume a 10-in. horizontal conveyor with a straight run of 200 ft., for a capacity for 40 tons per hour of coal. Without going through the details of the procedure for determining the power (see *Chem. & Met.*, Feb. 1944, p. 147ff.), the blower for a pneumatic conveyor will approximate 25 motor horsepower. A hydraulic conveyor will handle coal to about 10 percent by volume of the water. The volume of coal is 1,600 cu. ft. per hour, so the volume of water is 16,000 cu. ft. per hour, and the total volume of water and material is 17,600 cu. ft. per hour, or 293 cu. ft. per minute. The pump must function with clear water so the coal would be introduced into the duct through an air-lock beyond the pump. The head loss is 8.8 ft. in 200 ft. The weight of mixture is 64 lb. per cu. ft. The theoretical horsepower is $293 \times 64 \times 8.8 / 33,000 = 5$ water horsepower, i.e., a 10-hp. motor.

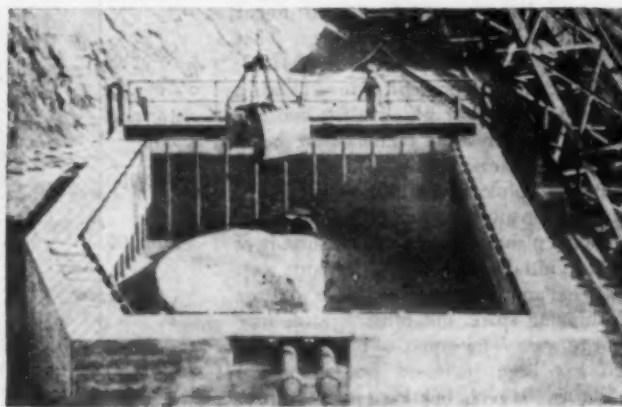
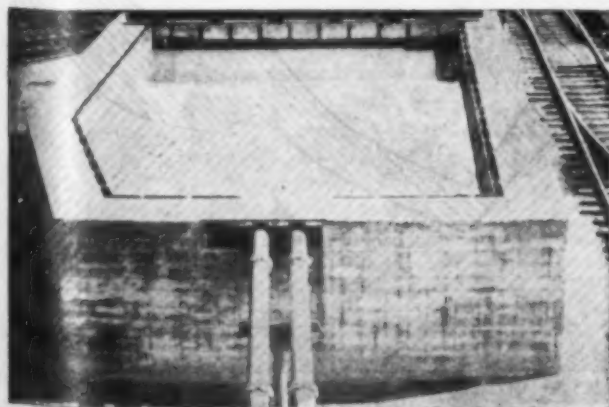
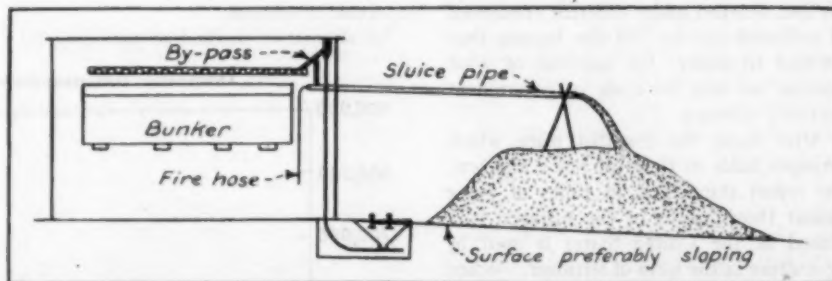
The ratio of air to coal in the pneumatic conveyor is 140:1. With the hydraulic, the ratio is 10:1. The hydraulic conveyor is more efficient because the conveying medium is denser, and with coal it is close to the weight per cubic foot of the material. As the specific gravity of the material goes up, the velocity of flow must be stepped up, causing the efficiency to go down.

Incidentally, the power for a belt conveyor for the same job, a 16-in. belt at 200 ft. per minute, would be 1.0 hp. for the empty belt, plus 0.5 hp. for the material, a total of 1.5 hp., requiring a 3-hp. motor.

The hydraulic conveyor is adapted to certain conditions. The theoretical problem just given is obviously not one of these.

Fig. 1—In smaller ash handling installations the ashes are usually discharged to a settling sump as at the left below which, after draining, can be emptied by a grab bucket

Fig. 2. Right—A few lengths of leader pipe and a stream from a fire hose served, as shown, to handle coal to a reserve storage area



POSTWAR UTILIZATION

Government Synthetic Ammonia Plants

The Department of Agriculture, investigating domestic markets for nitrogen after the war, presents a discussion of the nation's needs together with an analysis of ways and means for meeting these needs, which includes recommendations for the continued operation of at least some of the government synthetic ammonia plants—Editors

THE POSTWAR planning committee of the Department of Agriculture has made a study of domestic requirements for nitrogen in the immediate postwar period. While this study was undertaken primarily to determine the amount which would be needed for fertilizer use, it necessitated a comprehensive survey of total requirements and an appraisal of all sources of supply. The findings of this committee are of wide interest not only because they place a more or less definite range for supply and demand under different conditions of industrial activity, but also because they attempt to answer the question of what postwar use may be made of government synthetic nitrogen.

After fixing the essential place which nitrogen holds in times of peace and war, the report states that in times of peace almost three-fourths of the nitrogen consumed in the United States is used by agriculture in the form of fertilizer. When war comes agriculture's supply of nitrogen is restricted and uncertain, due to urgent military and industrial demands. That was the case in 1917, and again in 1942-43. After Pearl Harbor agriculture faced a shortage of fertilizer nitrogen for two seasons, at the very time farmers were being urged to increase production. A more serious and prolonged shortage was avoided by government construction of synthetic ammonia plants and government subsidy of Chilean nitrate imports. But imports were restricted and uncertain due to the shortage of shipping space and other hazards incident to war. The supply of fertilizer nitrogen has been increased beyond prewar levels in 1943-44, but even now there is

serious question as to our ability to supply fertilizer nitrogen in the amounts farmers would use for food, feed and fiber production in 1945.

Disregarding the probability of unfavorable conditions, the indicated annual consumption of 750,000 or 900,000 tons of nitrogen for fertilizer is almost double prewar consumption. The increase is expected as a result of a large increase in farm cash income, some reduction in nitrogen prices, and greater realization on the part of farmers of the profitable returns from the use of fertilizers. Fertilizer nitrogen consumption in 1943-44 was approximately 620,000 tons and would have been substantially greater except for several factors that tended to limit consumption.

Touching upon the question of supply, the committee finds that if nitrogen consumption increases to 1,000,000 or 1,200,000 tons, domestic production should be greatly increased. The plants owned by the government are needed to furnish 19 to 24 percent of the estimated nitrogen consumption under the two favorable conditions. Existing private plants and reduced imports would be adequate to meet probable consumption under unfavorable economic conditions.

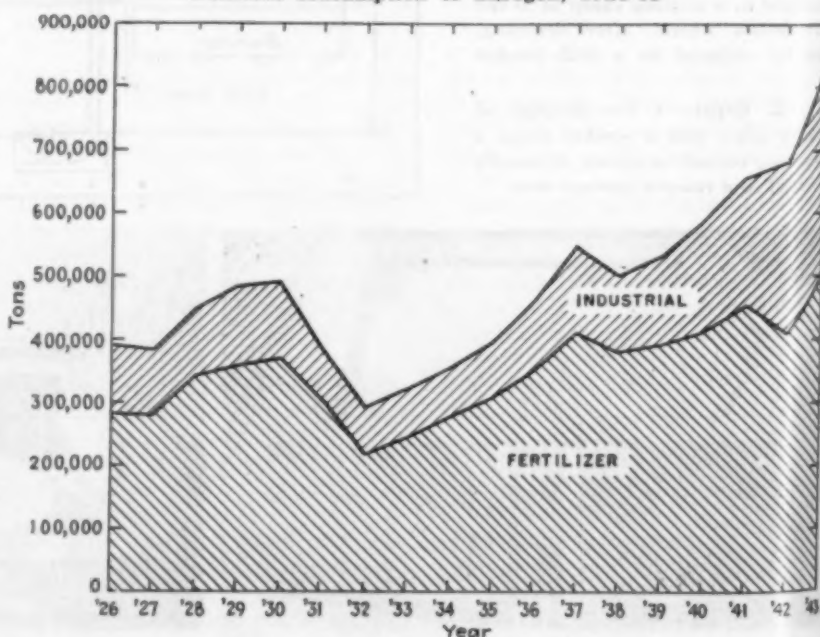
An alternative method of providing for

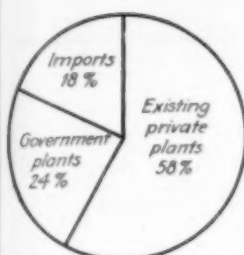
increased consumption would be to increase imports. In this connection the assumption should be noted that imports under favorable conditions would be as large as average imports in 1936-40, and that postwar imports of Chilean nitrate of soda would, under most conditions, be about as large as in the year preceding the war. While it is assumed further that no restrictions will be placed on imports, the estimates reflect the view that American farmers should not be under the necessity of using imported fertilizers at prices that are higher than would be necessary to purchase the equivalent quantities of plant food of domestic origin.

Lower fertilizer nitrogen prices are generally expected. They will be influenced by the general price level, government price policy, and the international or world price of nitrogen fertilizers. The war has caused a great increase in our fixed nitrogen production capacity, but there are no known technical developments that have reduced production costs. On the other hand, high labor and raw material costs have increased manufacturing costs when figured at a given rate of production.

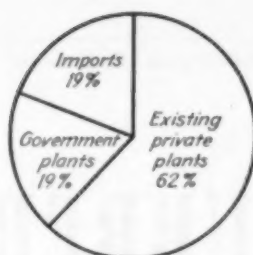
It seems possible that fertilizer nitrogen prices may be reduced to about 1934-36 levels if we assume good competitive con-

Domestic consumption of nitrogen, 1926-43

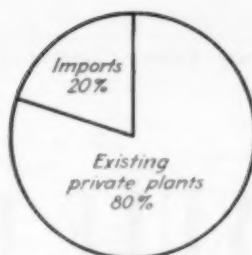




Most favorable conditions
1,190,000 tons



Favorable conditions
1,040,000 tons



Unfavorable conditions
675,000 tons

Estimated sources of nitrogen to meet postwar consumption

ditions, but no subsidization of production by government. In fact, the May, 1944 reduction in the prices of ammonia solutions has already brought the price of that important class of nitrogen material to the 1934-36 price level.

Looking into the future, the committee finds that the consumption of nitrogen by agriculture and industry will depend primarily on the level of national production and employment, demand for farm products, and price for nitrogen.

The government has invested more than \$200,000,000 in nine synthetic ammonia plants. They have a combined capacity of about 750,000 tons of fixed nitrogen per year. That is more than United States consumption for all purposes in any pre-war year. The plants are well located with respect to the fertilizer market.

Most of the plants produce anhydrous ammonia which is shipped to other factories producing military explosives. Certain of the plants, however, produce ammonium nitrate. Only one of these processes it to a form suitable for use as a fertilizer. In all plants an additional investment would be required to provide for fertilizer production by modern methods. This investment, while substantial, would be quite small as compared with the initial cost of the present plant, and would be justified financially by the savings in production cost. A further improvement in the physical properties of the product also would result.

As these plants came into full production they have, over considerable periods, produced more fixed nitrogen than was required for the military program. The War Food Administration and the War Production Board, working with the War Department, arranged for all surplus ammonia to be converted to nitrogen fertilizer. It was the production from the war plants that made possible the sharp increase in fertilizer nitrogen consumption in 1944.

From the estimates of future consuming requirements it is concluded that production of some of these plants will be needed in the postwar years. The working group of the Interbureau Committee on Postwar Programs therefore has recommended that plants with a combined capacity of about 300,000 tons N be converted for

the production of nitrogen fertilizers and other ammonia derivatives for civilian consumption.

The question as to the nitrogen fertilizers that should be produced at the converted war plants has been carefully considered. It seems probable that granular ammonium nitrate is the best material to produce at some, but possibly not all of the plants. Other nitrogen fertilizers that merit consideration are ammonium sulphate, urea, and sodium nitrate. Final decision on the product to manufacture presumably will be made by the organization operating the plant and selling the product.

Ammonium nitrate is one of the lowest cost nitrogen fertilizers that could be produced in the war plants. It is not only a low-cost material to manufacture, but being of high analysis can be distributed at a low cost per pound of nitrogen. Furthermore, several of the war plants are already partially equipped to produce ammonium nitrate.

In the 1943-44 fertilizer season approximately 300,000 tons of ammonium nitrate were used as fertilizers. Much of this tonnage was not in satisfactory condition, or at least was not in good condition. Production of the better grades of granular ammonium nitrate was not started until November, 1943. Further improvements have been made in recent months. The products being produced at most plants for the 1944-45 fertilizer season are entirely satisfactory for direct application and for use in the manufacture of complete fertilizers.

Referring to the desirability of early

action the report says that surplus ammonia from the war plants has been processed into nitrogen fertilizers by relatively expensive methods as compared with the recommended modern methods producing granular ammonium nitrate. Production costs would be considerably reduced if plant conversion for the production of granular fertilizer could be made in the near future. Such conversion would not interfere with the use of the plants when needed to meet military requirements. It would be a major step in putting the plants in readiness to meet postwar commercial consumption at prices that reflect full competitive use of the most efficient materials and methods. Prompt conversion could not be made for the entire capacity that will ultimately be needed to meet estimated consumption. Plans for the conversion of recommended capacity could be completed and ready for action upon termination of the war.

It is recommended that the government plants not converted to meet the estimated commercial consumption should be held as part of the nation's military equipment. The plants would be maintained in standby condition or operated to meet the requirements of our military forces. They would, of course, be available to meet unexpected civilian demands in times of peace.

The reserve plants would be just as much a part of our military forces as planes, tanks, ships and guns. The converted plants would help insure the production of future food and feed crops. The standby plants are "gunpowder" in reserve. In case of emergency each could help meet unusual needs.

In summarizing its findings, the committee recommends (1) United States ought to be prepared to supply up to 1,200,000 tons of fixed nitrogen for civilian consumption. (2) Plants of a combined capacity of 300,000 tons N, now operated by the government, should be converted to meet probable civilian consumption. (3) Conversion of some of the plants for the production of granular ammonium nitrate should be started as soon as possible. (4) All other government synthetic ammonia plants should be held as a part of the nation's military equipment.

Estimate of Future Prices for Nitrogen Fertilizers

	Wholesale, bulk		Retail, cash	
	per unit	per ton	per ton	per lb. N
Sodium nitrate, 16 percent N.....	\$1.50	\$24.00	\$35.00	10.9c
Ammonium sulphate, 20.5 percent N.....	1.17	24.00	35.00	8.5
Ammonium nitrate, 32.5 percent N.....	1.17	38.10*	47.10	7.3

* Refers to the material in bags.

Estimate of Future Consumption of Nitrogen

	1940 conditions	Most favorable conditions	Moderately favorable conditions	Unfavorable conditions
Farm cash income, \$ million.....	10,300	18,000	14,600	10,300
Expenditure for fertilizer, \$ million.....	237.5	482.9	391.3	276.4
Fertilizer nitrogen, 1,000 tons.....	413	900	750	500
Industrial nitrogen, 1,000 tons.....	175	290	290	175
Total N, 1,000 tons.....	588	1,190	1,040	675

GUAYULE RUBBER

Production Enhanced by New Process Methods

Recent cancellation of all projects for producing rubber from latex-bearing plants, with the lone exception of the program for rubber from guayule shrubs, serves to high-light the present method used for extraction at the Salinas, Calif., plant of the Emergency Rubber Project. New developments in process methods which improve both the efficiency of extraction and the quality of the final product have been added at Salinas and will be incorporated in a new plant now under construction at Bakersfield, Calif., for operation early next year.—Editors

EXTRACTION of rubber from guayule shrubs has currently followed the same process which was developed forty years ago by William A. Lawrence, a chemist, who was unaware that rubber existed in the latex form in the shrub and based his procedure on a mechanical separation of the coagulated rubber. Minor improvements have been made both in this country and in Mexico, but other processing difficulties which result in contamination of the finished rubber have not been remedied, and have in part retarded the development of this source of the natural rubber which is indispensable for compounding with synthetic rubbers for certain products. The recent extensive research work, started at the Eastern Regional Research Laboratory at Philadelphia and transferred a year ago to the Bureau of Agricultural and Industrial Chemistry laboratory at Salinas, has produced many improvements, features of which are being

incorporated in the present plant as well as in the new one at Bakersfield.

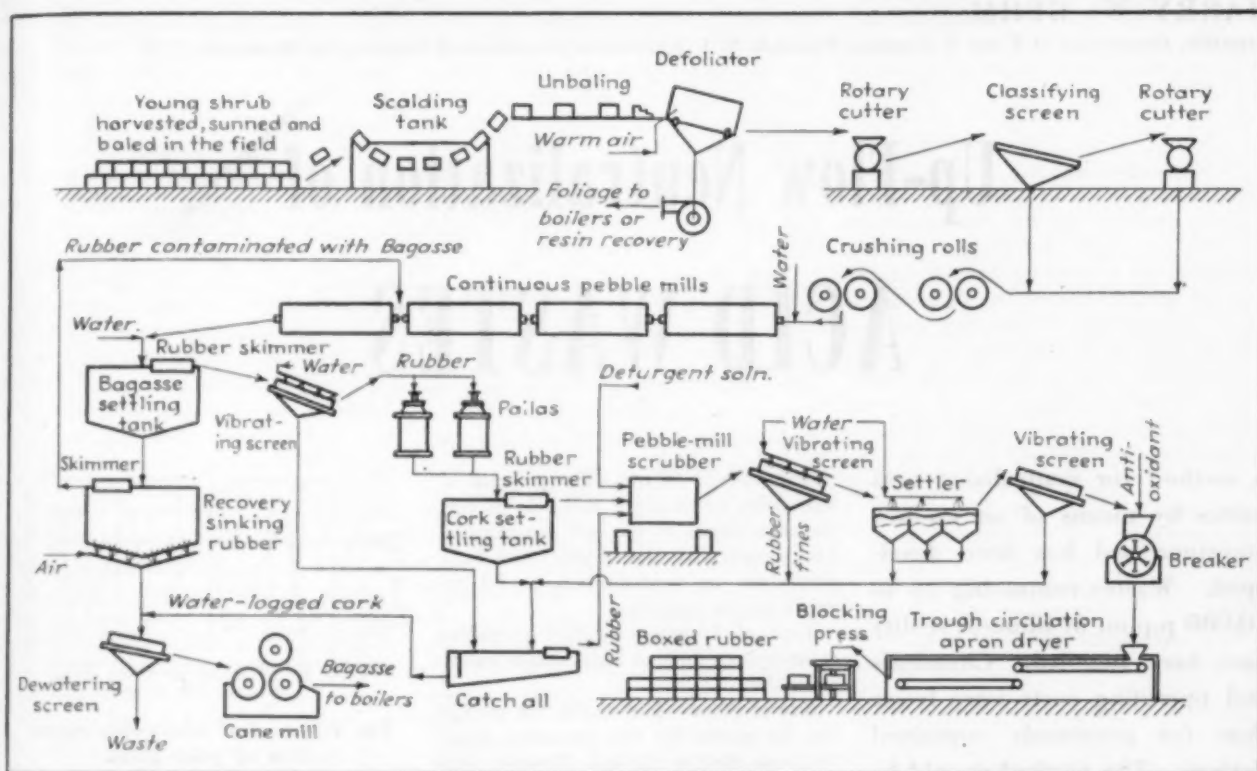
In the basic processes now being used in the Salinas plant the shrubs are stored for a period prior to processing to coagulate the latex and decrease the moisture content. Plant treatment consists first of chopping the shrub into chips after which moisture is reduced to an average content of 13-15 percent by means of a steam heated air dryer. The chopped shrub is passed through three sets of corrugated crushing rolls where the rubber cells are broken open and the rubber particles brought together or agglomerated. The crushed product is then mixed with about four and a half times its weight of water and is fed to a series of four silica-lined pebble tube mills. The time of passage through these four mills is approximately eighty minutes. Milling action results in maceration of the fiber and release of the agglomerated rubber from the rubber-bearing cells which exist for the most part directly under the bark. These small particles of rubber are further agglomerated

into particles which vary in size up to that of a grain of rice, and are called "worms." Worms are separated from the plant fibers by flotation in a Dorr thickener, the floating rubber with some particles of cork being skimmed from the surface. In the present process the plant fibers, or "bagasse," are wasted from the bottom of the thickener, but in the new plants they will be dried and burned for fuel.

Skimmed rubber, with contaminating particles of cork, is then subjected to hydrostatic pressure of 300 psi. for 80 min. at 200 deg. F. in vertical pressure vessels called, from the Spanish, "pailas." In this treatment the cork cells are de-aerated and the cork is waterlogged and settled out in a second flotation tank. The rubber worms are then given a final scrubbing in a small pebble mill to remove macerated vegetable material. Following this operation free water is removed from the worms in a hydraulic press. The worms are then dried in a tray vacuum dryer to a moisture content of about one percent

In Dorr selector, rubber "worms" float free of macerated woody material





Flowsheet of the improved process to be used at Bakersfield for the extraction of rubber from guayule

and pressed into 100-lb. blocks which are boxed for shipment.

The disadvantages which accrue in this method of processing are that the rubber is contaminated with resin-like material from the shrub as well as small amounts of macerated vegetable debris. The resin-like materials can be removed by subsequent solvent extraction of the rubber worms and the insoluble vegetable matter can be greatly reduced by mechanical and/or chemical means.

From the study of operations at the Salinas plant on the part of James Byrne,

Chief of Division of Engineering and as the result of research work by the Bureau of Agricultural and Industrial Chemistry laboratory, new process methods which will greatly improve the quality of the final product are being added at Salinas and installed in the Bakersfield plant. The improved process soon to be in operation at the Bakersfield plant is shown above.

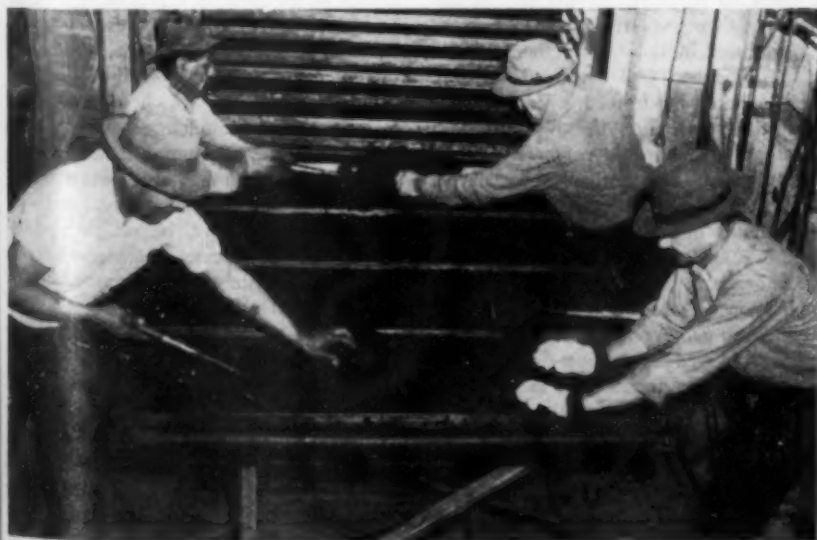
Defoliation of the shrub is the first of the major improvements to be incorporated in the new plants. Removal of leaves results in an increased capacity for the mills since leaves contain little or no rubber and

also interfere with milling operations. This operation is accomplished by immersing bales of shrub in boiling water for 10 min. after which bales are broken open and tumbled in a trommel. This action removes leaves which have been loosened by the boiling water. The next improvement consists of subjecting the chopped shrub to an aerobic fermentation or retting process which reduces the resin in the shrub and consequently in the finished rubber.

Other improvements will result in more efficient shrub and rubber handling and in improved rubber flotation and recovery after milling. The rubber refining or "scrubbing" process will be improved to such an extent that insolubles will be reduced to a minimum. The rubber worms will be dried in a continuous belt circulating air dryer which will result in rubber of higher quality because of shorter exposure to elevated temperatures. It may be that a solvent extraction unit will be added to the plants at a later date.

Possibly if Mr. Lawrence had realized originally that latex existed in an uncoagulated state in the green shrub, the process which he evolved would have followed a different pattern, and the history of guayule rubber development might have taken a different trend. Work on the extraction of rubber as latex has advanced to the pilot mill stage. Naturally this type of rubber will be of very high quality and will broaden the field of usage for guayule. If this process can be developed commercially it will no doubt contribute greatly to the growth of the guayule industry.

Spongy rubber from vacuum drier will be pressed into blocks for shipment



Up-Flow Neutralization of ACID WASTES

A method for neutralizing acid wastes by means of an up-flow limestone bed has been developed. Wastes containing up to 10,000 p.p.m. of mineral acidity have been handled. Chemicals and operating costs were lower than for previously conceived devices. The method should be useful to many plants annoyed by this problem.—Editors

A METHOD for neutralizing acid wastes by means of an up-flow limestone bed has been worked out on laboratory and pilot plant scale. This work has been reported (Gehm, H. W., *Sewage Works Journal*, Vol. 16, p. 104, January, 1944). The device showed promise of being simple to construct and operate. Since then inquiries concerning full scale design and operation of such a device have been received. It is proposed, therefore, to review briefly the published data which relate to design and operation of such a unit and with this information in mind, develop a tentative design and operating technique.

The main factors involved in the practical application of this process were found to be the following:

Total Acidity of Waste—Wastes containing up to 10,000 p.p.m. of mineral acidity were successfully handled by pilot plant. Higher acidities led to excessive gas evolution and instability of the bed. Predilution to or below this concentration is required for some wastes.

Sulphuric Acid Acidity of Waste—The concentration of sulphuric acid should not exceed 5,000 p.p.m. at any time, as such concentrations destroy the reactivity of the bed. Predilution can be employed to eliminate this difficulty.

Acid Salts in Waste—The presence of appreciable quantities of acid salts reduces the effectiveness of the bed considerably. This is particularly true of salts which form precipitates on neutralization, as for example ferrous sulphate.

Type of Limestone—Either crystalline or amorphous stone of high calcium variety is suitable.

Size of Stone—The smaller the particle size the greater the area presented, hence the more effective the bed. However, very small sizes tend to wash out at the high flow rates employed. Best results were obtained by using number two chick gravel which had the following sieve analysis:

	%
Retained on U. S. standard 7 mesh screen	0.0
Retained on U. S. standard 8 mesh screen	1.6
Retained on U. S. standard 10 mesh screen	15.6
Retained on U. S. standard 20 mesh screen	81.8
Retained on U. S. standard 60 mesh screen	0.5
Passed U. S. standard 60 mesh screen	0.5

This material is readily available, is 75 percent as efficient as high calcium hydrate, and generally sells for but 60 percent of the market price of hydrate. This represents a saving in neutralization cost of over 20 percent.

Rate of Application of Waste—For practical purposes the rate of application of waste to the filter should not be less than 20 gal. per sq. ft. per min., as velocities produced by flows lower than this fail to keep the bed well expanded and will not eliminate gases formed, silica and other impurities remaining after dissolution of the stone at a sufficiently high rate. Rates of application higher than 100 gal. per sq. ft. per min. have been employed experimentally but have the disadvantage of requiring excessive free board and have the tendency to wash out stone. Rates of application of waste should range between 20 and 100 gal. per sq. ft. per min.

Depth of Bed—Bed depths of from one to four feet were found to be mechanically satisfactory. As the neutralizing capacity was found to be in linear relationship with acidity of the applied waste and bed depth, the following equation serves as a guide in determining the most practical depth

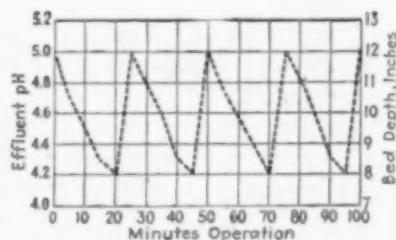


Fig. 1—Chart of continuous operation of pilot plant

for given conditions of acidity and rate of application:

$$R = (68 - KA)d$$

Where R is rate of application of waste in gal. per sq. ft. per min.; d is depth of bed in ft.; A is mineral acidity in 1,000 p.p.m. CaCO_3 ; and K is constant for stone size. K is equal to 8 for No. 2 chick gravel (10/20 mesh stone).

DESIGN RECOMMENDATIONS

Starting at the influent end of the plant means must be provided to obtain for treatment a waste with a mineral acidity of less than 10,000 p.p.m. (as CaCO_3), containing less than 5,000 p.p.m. of the acidity in the form of sulphuric acid. The acidity of waste should not exceed a predetermined limit at any time. These requirements can be met by providing an equalizing tank into which waste coming from the plant is discharged. If necessary, dilution water can be pumped from the receiving stream at a rate which when mixed with waste will maintain mineral and sulphuric acid acidities below the predetermined level. In cases where intermittent discharge of waste is involved, arrangement for automatic starting of both the dilution water and treatment unit pumps can readily be installed.

The pump used to apply waste to the bed should be capable of passing waste through the bed at several rates within the range of 20 to 100 gal. per sq. ft. bed area per min., depending upon the waste handled. The most adaptable range is between

20 and 60 gal. per sq. ft. per min., and three rates of discharge within this range should provide adequate flexibility required for changing conditions. All equipment on the acid side of the bed should be constructed of materials capable of withstanding the acids handled.

The distribution and support plate for the limestone can be selected on the basis of the presence of suspended solids in the waste, their size and character. For wastes free of suspended solids, carborundum plates, such as those used for underdraining sand filters, are well adapted. Where suspended solids are present in a very finely divided state, screens of 30 to 60 mesh supported by grills or slatted plates of tapered slot design are suitable. For wastes containing suspended solids of all but the finest varieties, nozzle distributions combined with a silicious gravel or glass bead layer over them would probably work best. The fact that only small concentrations of suspended solids become appreciable when concentrated by straining must be taken into account and means of distribution must be chosen which will not accumulate such matter, but pass it freely.

Sufficient freeboard must be allowed in the column containing limestone to prevent carryover when the stone is expanded by the waste flow. As shown by Fig. 1, over 50 percent expansion occurs at the rate of 60 gal. per sq. ft. per min. It would be advisable to allow 100 percent free-

board over the bed level, as gas bubbles at times carry limestone particles higher than the stable level of the expanded stone. Another precaution which might be warranted is placement of a 20-mesh screen at the top of the column. The table shows the expansion observed at various rates of flow.

Flow Rate, Gal. per sq. ft. per min.	Expansion, Percent
20	13
30	17
40	23
50	39
60	54

Overflow weir and effluent piping must be made of sufficient size to permit free discharge of the maximum flow of neutralized waste. If possible a fall or cascade of the effluent should be incorporated in the design to allow partial CO_2 removal from the treated waste which will result in a considerable pH rise, because the pH value of the liquor as it leaves the bed approaches 4.2. Provision for obtaining continuous representative samples of the bed effluent prior to cascading should be provided. The relation between time of aeration and rise in pH values is about as follows:

Aeration time, min.	pH
0	4.3
1	6.8
2	7.2
5	7.8
10	8.0

When cascades are used, the following may be expected:

	pH
Waste leaving bed	4.5
1-3 ft. falls	5.5
2-3 ft. falls	6.4
3-3 ft. falls	7.1

Enclosure of the upper section of the column is necessary where indoor installations are made, because the large quantities of CO_2 released would constitute a hazard. If such enclosure is made, means of providing an adequate opening for inspection and means of exhausting the gas should be provided. Such an exhaust should aid removal of CO_2 from solution on cascading. A gas passing from solution would be immediately removed and would probably prove beneficial in any installation of this type.

Replacement of dissolved limestone could be accomplished by a screw conveyor so arranged as to operate on signals from a pH recorder, measuring the pH of the waste just after passage through the stone. For example, the starting operation might be set for the pH value of 4.3, at which point the bed is just deep enough to remove mineral acidity, and to stop at the pH value of 5.5 or any value indicative of a maximum column of stone. In this manner the feed of stone would be automatically regulated.

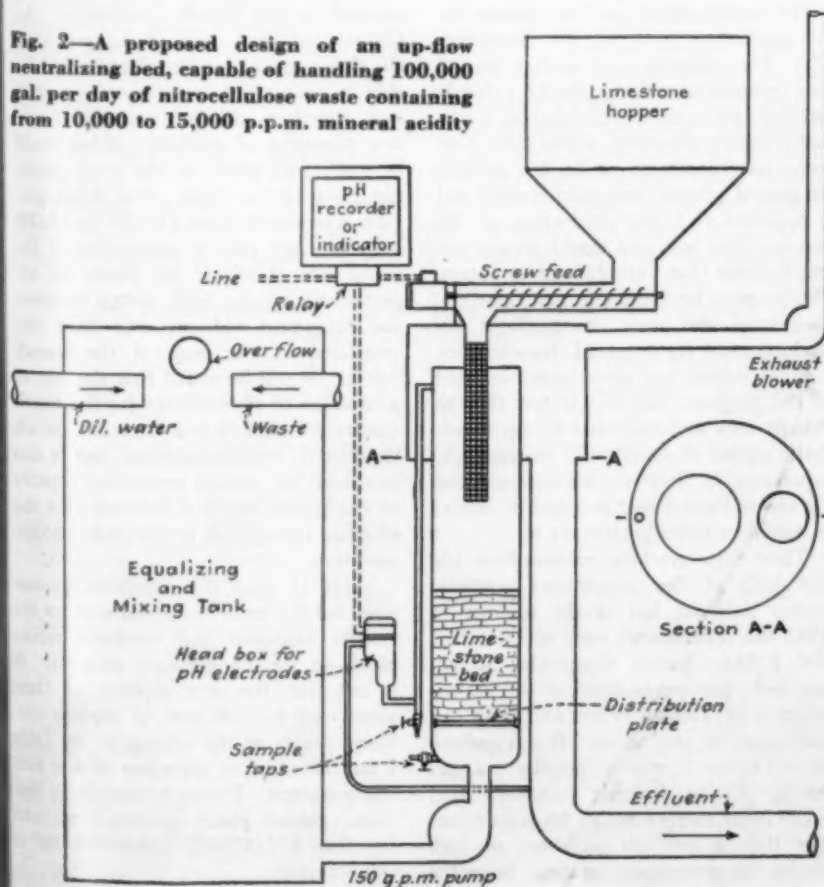
CONTINUOUS OPERATION

The chart shown in Fig. 1, which was taken from the pilot plant, illustrates how this arrangement would operate. The waste treated contained 4,230 p.p.m. mineral acidity and was passed through the bed at the rate of 40 gal. per sq. ft. per min. At the end of 20 minutes the bed had shrunk from 12 to 8 in. unexpanded depth, and the pH dropped to 4.2. Sufficient stone was then added to raise the unexpanded depth again to 12 in., after which the pH rose to the original value of 5.0.

In Fig. 2 a proposed design of an up-flow neutralizing bed, capable of handling 100,000 gal. per day of nitrocellulose waste containing from 10,000 to 15,000 p.p.m. mineral acidity, is illustrated. Means for dilution of the waste with an equal volume of water is provided and a total flow capacity of 216,000 gal. per day is provided for in the bed. Attention is directed to the small size of the bed, which is only 2 ft. in diameter. This and the possibility of constructing most of such a device of wood gives it a very low capital cost.

Operating costs should be lower than for previously conceived devices, because once adjusted, the only operation outside of a checkup on each shift would be that connected with supplying the hopper with fresh stone. The low cost of the neutralizing agent used must also be considered when this device is evaluated.

Fig. 2—A proposed design of an up-flow neutralizing bed, capable of handling 100,000 gal. per day of nitrocellulose waste containing from 10,000 to 15,000 p.p.m. mineral acidity



Plant Investment and Production Costs for SYNTHETIC RUBBER

This article is based, practically without change, on a special report of the Office of the Rubber Director which was issued by the Director, Col. Bradley Dewey, on Aug. 31, 1944. Based on figures supplied by the Rubber Reserve Co. it presents the first complete and authoritative picture of the investment and operating costs involved in the Government synthetic rubber program. What part of this capacity may be operated after the war, and by whom, are questions not yet answered. Nevertheless the report should be required reading for all who are in any way interested in rubber.—Editors

TO MEET a national emergency the United States government undertook the production of synthetic rubber and the main essential ingredients for its manufacture. In this program, monetary considerations were definitely secondary to obtaining a sure supply of synthetic rubber in the shortest possible time.

To insure the success of this program in almost untried fields, it included a variety of different processes for the production of raw materials as well as several different types of synthetic rubbers.

The following considerations were important in selecting processes:

1. The probable adaptability of the final product to replace natural rubber.
2. State of development of a process.
3. The availability of the basic raw

Note: This article is based on cost figures submitted by Rubber Reserve Co. as supervisors of the Government-owned synthetic rubber plants. Most of these plants were provided for by the program originally laid out by Rubber Reserve Co. and finished in accordance with the instructions of the Baruch Committee that they be "bushed through" to completion without further change.

materials necessary for the production of the polymer and the necessary intermediates.

4. Military and industrial needs for special polymers.

5. The estimated time of construction.

6. The use of certain critical materials.

On the basis of these considerations Buna-S was chosen as the best general purpose rubber and became the backbone of the program. Butadiene and styrene, the two principal ingredients of this polymer, were being produced on a small scale and some of the technical problems concerned with their manufacture were known. In addition, several companies had carried out extensive research and development work over a period of years.

The second main synthetic chosen for the government program was Neoprene-GN. This polymer had been produced on a commercial scale for almost a decade and had demonstrated its value as a synthetic rubber. However, at the time Neoprene was considered to be less suitable for general purpose uses than Buna-S and it appeared that the production of the necessary raw materials would require certain facilities that were difficult to obtain. The program for Neoprene was, therefore, limited to the need contemplated for products requiring its special characteristics.

Butyl rubber was also chosen for part of the program, but it was felt that although data indicated that it was a synthetic rubber of considerable promise, the experience in both its manufacture and use was so limited that it would be unwise to gamble a major portion on it.

These three synthetic rubbers form the real basis of the government synthetic rubber program, but in the summer of 1942 the uncertainties were so great that the Rubber Survey Committee recommended the production of a limited quantity of Thiokol N for retreading and passenger tire production. It was realized that Thiokol N was a specialty polymer having solvent resisting properties that made it extremely valuable for certain uses but that it was not a rubber of high quality for general purpose uses. Since the

raw materials and facilities that could be easily adapted to the polymerization were readily available, the Baruch Committee recommended a capacity of 60,000 tons per year. It was later found that due to the effectiveness of various conservation measures adopted and a rapid increase in the production of reclaimed rubber, it was possible to meet the situation without the use of Thiokol N and early in 1943 production as a general purpose rubber was abandoned.

In Table I the resultant program is compared with the recommendations of the Baruch Committee. It will be noted in the table that there is considerable difference between the rated capacities of the present program and those recommended by the Baruch Committee. As the program was built, it became obvious that a number of the plants would be able to operate at over capacity and it was, therefore, decided that the necessary quantities of synthetic rubber could be made with plants of the rated capacities given in the table. The Butyl program was rerated from 132,000 to 68,000 long tons per year in recognition of the actual rate at which the plants are expected to operate with certain revisions and equipment additions over those contemplated at the time of the Baruch report. It will be noted that the rate of production of all synthetics for the fourth quarter of 1944 is less than the Baruch Committee recommendations; this is also less than the present productive capacity of the plants, but it is believed that the schedule corresponds to the probable consumption.

Table II gives the capacities, production, and the estimated investment for the various monomer and synthetic rubber plants in the Government program. It is felt that the over capacity of these plants will be sufficient to produce synthetic rubber at the rates given in Table I for the ultimate capacities of the various synthetics. Private investment in synthetic rubber plants estimated to total less than \$50,000,000 is not included in this summary.

Table III—Plant Investment Cost per Annual Long Ton Capacity of Synthetic Rubber

	U. S. Government Buna S	
	Basis 1*	Basis 2†
Butadiene investment.....	324	350
Styrene investment.....	71	91
Miscellaneous chemicals and facilities investment.....	14	14
Copolymer investment.....	178	178
Total investment.....	587	663

Note: Basis 1 butadiene and styrene investments are less than Basis 2 since the ultimate capacities of the butadiene and styrene plants are greater than the ultimate capacities of the copolymer plants. If the full operation of these plants is made possible by outside sales, Basis 1 applies; if their production is limited solely to Buna-S demand, Basis 2 applies. Basis 1 assumes 0.815 short tons of butadiene and 0.250 short tons of styrene are required per long ton of Buna-S.

* Average investment per annual ton of estimated individual actual butadiene, styrene, and copolymer capacity, in dollars per long ton of Buna-S.

† Average investment per annual ton of estimated actual copolymer capacity, in dollars per long ton of Buna-S.

All U. S. Government Synthetics

	Investment per Long Ton Estimated Actual Capacity
Buna S, basis 1 above.....	\$587
Buna S, basis 2 above.....	663
Butyl.....	779
Neoprene-GN.....	717
Average (Buna S on basis 2) all synthetics.....	675

It will be noted from Table III that the plant investment cost per ton of capacity for the three synthetic rubbers, Buna-S, Butyl and Neoprene, indicates that the amount of equipment required is roughly the same. There are investments in private plants to produce such raw materials as alcohol, butylenes, naphtha, butane, ethylene, calcium carbide, soap and other necessary ingredients which are not included in the above study.

PRODUCTION COSTS

While the investment and operating costs were not the major consideration in establishing the government program,

these are very important in indicating the postwar possibilities of the various materials. Today the operation of most of the government-owned plants has progressed far enough that a reasonably accurate picture can be obtained of both the present production costs as well as those likely to be realized in the future.

The following cost analysis has been based on the out-of-pocket operating charges. It does not contain any provision for amortization, sales expense, profit or interest on investment. However, it does include plant insurance, taxes, nominal royalties and a small management charge to cover expenses which are not capable of direct allocation and which may or may not include some profit.

Amortization and interest on investment were not included in the considerations because of the uncertainty as to the basis on which the government will handle its investment. Also, the uncertainties in this country's rubber policy are so great that any estimates of selling expense on a postwar basis are meaningless. The profits necessary to make the operation attractive are a function of the risks entailed in the private operation of the plants and they, too, cannot be accurately evaluated for the same reason that selling expense is uncertain. Therefore, all of the costs in the following discussion exclude these four items and the resultant cost is the direct or out-of-pocket cost.

NEOPRENE-GN

Table IV presents the approximate current operating costs for Neoprene-GN, together with an estimate of its possible postwar cost. This cost includes feed-stock and direct operating costs, but excludes amortization, preliminary expense and research. It will be seen from the table that the present costs average approx-

Table IV—Neoprene-GN and Butyl Plant Operating Costs

(Cents per pound of product including feed stocks but excluding amortization, preliminary expense, research)

	Neoprene-GN		
	Present Cost Acetylene, 11.67C./Lb.	Post-War Cost Acetylene, 7.00C./Lb.	Butyl Present Cost
Production materials:			
Feed stocks.....	11.10	6.70	2.51
Other chemicals.....	4.19	4.19	4.12
Sub-total.....	15.29	10.89	6.63
Utilities.....	1.33	1.33	1.71
Other costs:			
Operating labor.....	1.50	1.39	3.51
Supervision.....	0.13	0.13	0.20
Repairs and maintenance.....	1.22	1.22	3.08
Operating supplies.....	0.79	0.79	....
Laboratory.....	0.30	0.30	0.92
Packing and shipping.....	0.29	0.29	0.76
Plant overhead.....	....	....	2.75
Salaries, wages.....	1.29	1.19	....
Insurance.....	0.05	0.05	0.14
Taxes.....	0.04	0.04	0.06
Miscellaneous.....	0.40	0.40	0.25
Sub-total.....	6.01	5.80	11.67
Royalties and management fees.....	1.80	1.75	1.50
Total.....	24.52	19.77	21.51
By-product credit.....	-0.48	-0.40	....
Total out-of-pocket.....	24.04	19.58	21.51

imately 24 cents per pound of Neoprene-GN, with acetylene purchased at 11.67 cents per pound. It has been estimated that acetylene may sell for approximately 7 cents per pound in the postwar market. This may result in reducing the cost of Neoprene to approximately 19 cents per pound. High as these costs may appear to be, Neoprene-GN, as a result of its special properties, should play an important part in the future rubber field.

BUTYL

The government Butyl program is comprised of two plants, one located at Baton Rouge, Louisiana, operated by the Standard Oil Co. of Louisiana, and the other located at Baytown, Texas, operated by Humble Oil & Refining Co. The Baton Rouge units have been in operation for up to 13 months whereas the construction on the Baytown plant is still being completed. Major operating difficulties have been experienced with the Baton Rouge plant. These have necessitated an extensive research and development program and major alterations to all of the units are being installed.

To date the maximum month's production for the Baton Rouge plant has been 41 percent of rated capacity. On the basis of this reduced operation it will be seen from Table IV that Butyl rubber is being manufactured for an average operating cost including feed-stocks of 21½ cents per pound.

The above-mentioned research and development program, together with the alterations, should enable the Butyl plants

Table I—Comparison of Present Rubber Program with Baruch Committee Recommendations

	Synthetic Rubber in Long Tons			Estimated Ultimate Annual Capacity with Present Plants, U. S. and Canada	Estimated Annual Rate 4th Quarter 1944, U. S. and Canada
	Baruch U. S. Only	Present U. S. Only	Present U. S. and Canada		
Buna S.....	\$45,000	705,000	735,000	1,000,000	780,000
Butyl.....	132,000	68,000	75,000	75,000	38,000
Neoprene-GN.....	60,000	*63,000	*63,000	70,000	57,000
Thiokol-N.....	60,000			Program suspended	
Total.....	1,106,000	836,000	873,000	1,145,000	875,000

* Including 14,000 additional tons of neoprene plant capacity scheduled for completion during 1944.

Butadiene, Short Tons

	Rated Annual Capacities		
	Baruch U. S. Only	Present U. S. Only	Present U. S. and Canada
From grain or alcohol.....	247,000	230,000	230,000
From butane.....	60,000	75,000	75,000
From butylene.....	250,000	250,000	280,000
From naphtha.....	125,000	37,600	37,600
From combination of butylene and naphtha.....	85,000	55,000	55,000
From natural gas by aldol.....		10,000	10,000
Total.....	767,000	657,000	687,000

to operate at capacities approaching rating. While it is not possible to predict accurately the ultimate costs on the basis of present experience, it is believed that Butyl rubber may be manufactured at an operating cost, including feedstocks, of 10 to 14 cents per pound. However, its status as general purpose rubber is still uncertain and it will take large scale manufacture, consumption and use before its ultimate position is determined.

BUNA-S

At the present stage of the program the most important evaluations of production costs are those for Buna-S type rubbers. It is the main general purpose synthetic rubber and will probably be the chief competitor of natural rubber. For

these reasons the following cost analysis is largely limited to Buna-S and to its raw materials.

BUTADIENE

The Government butadiene program involves a number of different processes but it can be divided into four main categories based on the feed stocks employed: (1) Alcohol; (2) butylene; (3) butane; and (4) naphthas or other petroleum fractions.

1. Alcohol Process—So far, the greatest tonnage of butadiene has been produced from alcohol and over the next six months it may still account for more than half of all production. It will be noted from Table II that the investment cost per ton of rated capacity is moderate and when it is considered that the

plants have operated at over 180 percent of rated capacity, the investment per annual ton of butadiene, based on actual production, is less than \$300. The alcohol butadiene program involves three plants containing 11 identical units each having an original rated capacity of 20,000 short tons of butadiene. The process was developed, designed and engineered by the Carbide & Carbon Chemicals Corp. Two of the plants contain four units each, one located at Institute, West Virginia, operated by Carbide & Carbon, and one located at Kobuta, Pennsylvania, operated by the Koppers United Co. The third plant of three units at Louisville, Kentucky, is operated by Carbide & Carbon.

These plants have operated for over a year and their production costs are well determined. Average production costs from the three plants, above the cost of the alcohol feed stock for the butadiene, are summarized in Table V. The operating charges of approximately 2 cents per pound of butadiene are small in com-

Table II—Summarized Rubber Program Capacities, Production and Investment

(Butadiene Quantities in Short Tons)										
Plant Location and Source of Funds		Operator	Rated Cap., Tons per Year	Month of First Prod.	Total Prod. Thru 6/44, Tons	% of		Estimated investment		
						Rated Max. Mo. Prod.	Cap. Est. Ult. Cap.	* Total	Per Ann. Ton Rated Cap.	Per Ann. Ton Ult. Cap.
BUNA-S										
Butadiene¹										
From alcohol:										
Institute, W. Va. (G).....	Carbide & Carbon Chem. Corp....	80,000	Feb. 1943	151,190	201	180	\$39,308,036	\$401	\$273	
Louisville, Ky. (G).....	Carbide & Carbon Chem. Corp....	60,000	Aug. 1943	74,800	181	180	35,731,028	595	330	
Kobuta, Pa. (G).....	Koppers United Co.....	80,000	July 1943	95,280	177	180	* 41,508,036	519	258	
Subtotal (G).....		220,000		321,370	...	180	116,547,100	530	394	
From butylene:										
Baton Rouge, La. (G).....	Standard Oil Co. of Louisiana....	15,000	May 1943	20,600	156	150	* 8,600,000	573	383	
Baytown, Tex. (G).....	Humble Oil & Refining Co.....	30,000	Aug. 1943	22,210	120	135	19,400,000	647	490	
Lake Charles, La. (G).....	Cities Service Refining Corp.....	55,000	Aug. 1944	.....	...	100	17,000,000	309	309
Port Neches, Tex. (G).....	Neches Butane Products Co.....	100,000	Feb. 1944	18,180	106	135	58,686,196	587	436	
Houston, Tex. (G).....	Sinclair Rubber, Inc.....	50,000	Apr. 1944	3,580	63	135	31,500,000	630	467	
Subtotal (G).....		250,000		64,570	...	128	135,186,196	541	422	
From naphtha and gas oil:										
Baton Rouge, La. (G).....	Standard Oil Co. of Louisiana....	6,800	Mar. 1943	8,820	117	100	2,000,000	294	294	
Ingleside, Tex. (G).....	Humble Oil & Refining Co.....	7,000	Oct. 1943	4,180	95	100	4,100,000	586	586	
El Dorado, Ark. (G).....	Lion Oil Refining Co.....	6,700	Oct. 1943	* 1,340	38	50	2,300,000	343	686	
Corpus Christi, Tex. (G).....	Taylor Refining Co.....	5,800	Apr. 1944	* 70	11	25	1,800,000	327	1,310	
Subtotal (G).....		26,000		11,000	...	71	10,200,000	393	583	
Combination from naphtha and butylene:										
Los Angeles, Calif. (G).....	Southern California Gas Co.....	30,000	July 1943	* 10,860	81	100	13,500,000	450	430	
Los Angeles, Calif. (G).....	Shell Chemical Division.....	25,000	May 1944	12,640	* 59	120	21,000,000	840	700	
Subtotal (G).....		55,000		12,640	...	109	34,500,000	628	578	
From butane:										
Borger, Tex. (G).....	Phillips Petroleum Co.....	45,000	Sept. 1943	14,040	61	100	35,000,000	778	778	
El Segundo, Calif. (G).....	Standard Oil Co. of California....	15,000	Apr. 1944	1,710 + 930	74	125	7,700,000	513	410	
Toledo, Ohio (G).....	Sun Oil Co.....	15,000	June 1944	30	22	100	7,500,000	500	800	
Subtotal (G).....		75,000		15,780	...	105	50,200,000	670	638	
Total U. S. Gov.....		626,000		425,360	...	139	346,833,296	553	398	
Other plants:										
Baton Rouge, La. (P).....	Standard Oil Co. of Louisiana....	6,000								
Charleston, W. Va. (P).....	Carbide & Carbon Chem. Corp....	5,000								
Philadelphia, Pa. (P).....	Publicker Comm. Alcohol Co.....	10,000								
Bishop, Tex. (P).....	Celanese Corp. of America.....	10,000								
Sarnia, Canada (C).....	Imperial Oil, Ltd.....	30,000								
Subtotal.....		61,000								
Grand total, butadiene plants		687,000								

¹ Private butadiene plants of Dow Chemical Co., Shell Chemical Division of Shell Union Oil Co., United Gas Improvement Co., Phillips Petroleum Co. and Standard Oil Co. of Louisiana in operation prior to the inception of the government program not listed. ² After completion of scheduled additions, the estimates which in some cases may be conservative are felt to correspond to the production rate over an extended period without sacrifice in product quality or plant efficiency. In case of new plants may operate at higher rates for short periods. ³ G—U. S. Government; P—Private; C—Canadian Government. ⁴ Basis for these figures is not comparable in all cases due to sizeable utilities investments in some plants

whereas other plants purchase utilities directly from outside suppliers. ⁵ Crude butadiene produced for subsequent purification. These figures not included in totals. ⁶ Does not include outside crude butadiene production purified in addition to own production. ⁷ Applies only to specification butadiene produced; crude production purified elsewhere excluded. ⁸ Kobuta project consists of 80,000 tons per year butadiene plant and 37,500 tons per year styrene plant costing \$41,508,036. Cost of styrene plant is here arbitrarily set at \$20,000,000 leaving \$41,508,036 for butadiene. ⁹ Baton Rouge project includes pilot plant no longer in operation which is arbitrarily evaluated at \$1,000,000. Total project estimated at \$9,-

600,000. ¹⁰ Maximum month's production of Neches is for one of two units only. ¹¹ Purification plant of sufficient size to handle crude butadiene produced at El Dorado in addition to own production. ¹² Purification plant of sufficient size to handle crude butadiene produced at Corpus Christi in addition to own production. ¹³ Crude butadiene production only. ¹⁴ Purification plant of sufficient size to handle crude butadiene produced at Southern California Gas in addition to own production. ¹⁵ Naphtha Cracking Process. ¹⁶ Thermal Cracking Process. ¹⁷ Alcohol Process. Not in operation. ¹⁸ Process. Not in operation. ¹⁹ Butylene Hydrogenation Process.

parison to the cost of the alcohol employed, which for an ultimate yield of 2.25 lb. of butadiene per gallon of 190 proof alcohol, amounts to about 40 cents per pound of butadiene with the present alcohol price in the vicinity of 90 cents per gallon. Therefore, the economics of the alcohol butadiene process are largely those of industrial alcohol production and the resulting cost of the butadiene is given in Fig. 1, as a function of alcohol price. Estimates on industrial alcohol for large scale consumption after the war have ranged from as low as 12 cents to as high as 20 cents per gallon. Using a somewhat optimistic price of 15 cents per gallon the resultant direct cost of the butadiene is estimated to be 8½ cents per pound.

2. Butylene Dehydrogenation Process—The main process for the production of butadiene in the petroleum field is based on the dehydrogenation of normal butylene. The process was developed by the Standard Oil Development Co. but has

been modified and adapted by a number of operators using this process to fit different feed and product purification systems. The estimated operating costs for these plants, above the cost of butylenes, as given in Table V are considerably higher than those for the alcohol butadiene plants. Consequently, any reduction in these charges plays a much more important part in the cost of the butadiene produced.

At the present time the larger dehydrogenation plants have not achieved stabilized operation and therefore, their operating costs have fluctuated widely. For that reason the estimates given in Table V are based mainly on the cost data available on two of the smaller dehydrogenation plants. However, they have been adjusted to some extent to reflect the expected ultimate cost for the larger units. An attempt has been made to forecast these operating costs for the postwar period and the results are presented in the same table. The cost of

the butylenes necessary to produce a pound of butadiene depends on both the market price of butylene and the ultimate level of the yields (utilization). Consequently, in Fig. 2 the butadiene cost is presented as a function of the butylene utilization (pounds butadiene produced per pound butylene consumed) and the net cost of butylenes themselves. Currently butylenes range from about 8 to 12 cents a gallon and the utilization ranges from 0.60 to 0.75. With 0.65 utilization and 9½ cents per gallon butylene (about present average value), butadiene costs approximately 7.6 cents per pound. In the postwar picture it should be possible with a utilization of 0.65 and butylenes available at 6 cents per gallon to produce butadiene by this process for as low as 6.4 cents per pound.

3. Butane Dehydrogenation Process—Three plants are included in the Government program to produce butadiene from butane. One of these was developed and designed by the Phillips Petroleum Co.,

Table II (Cont.)—Summarized Rubber Program Capacities, Production and Investment

(Styrene Quantities in Short Tons; Copolymer and Other Rubber Quantities in Long Tons)

Plant Location and Source of Funds	Operator	Rated Cap., Tons per Year	Month of First Prod.	Total Prod. Thru 6/44, Tons	% of Rated Cap.		Estimated investment							
					Max. Mo. Prod.	Est. Ult. Cap.	Total	Per Ann. Ton Rated Cap.	Per Ann. Ton Ult. Cap.					
BUNA-S (Cont.)														
Styrene														
Velasco, Tex. (G).....	Dow Chemical Co.....	50,000	Sept. 1943	30,120	117	175	\$18,180,000	\$363	\$207					
Los Angeles, Calif. (G).....	Dow Chemical Co.....	25,000	June 1943	17,920	116	175	15,000,000	600	343					
Texas City, Tex. (G).....	Monsanto Chemical Co.....	51,000	Mar. 1943	36,780	117	160	10,700,000	386	241					
Institute, W. Va. (G).....	Carbide & Carbon Chem. Corp.....	25,000	May 1943	16,020	111	100	9,900,000	396	306					
Kobuts, Pa. (G).....	Koppers United Co.....	37,500	Aug. 1943	20,950	102	140	20,000,000	533	381					
Total U. S. Gov. styrene (G).....		158,500		121,790	...	154	82,750,000	439	285					
Midland, Mich. (P).....	Dow Chemical Co.....	4,200			...	...						
Sarnia, Canada (C).....	Dow Chem. Co. (Canada) Ltd.....	10,000			...	...						
Subtotal.....		14,200			...	...						
Grand total styrene.....		202,700			...	...						
Copolymer														
Baton Rouge, La. (G).....	Copolymer Corp.....	30,000	Apr. 1943	39,270	142	130	\$7,536,853	\$251	\$103					
Borger, Tex. (G).....	B. F. Goodrich Co.....	45,000	Aug. 1943	23,120	101	130	8,080,272	199	153					
Louisville, Ky. (G).....	B. F. Goodrich Co.....	60,000	Nov. 1942	63,210	121	130	11,742,758	196	151					
Port Neches, Tex. (G).....	B. F. Goodrich Co.....	60,000	Aug. 1943	25,000	114	130	16,584,896	276	212					
Akron, Ohio (G).....	Firestone Tire & Rubber Co.....	30,000	June 1942	45,370	142	130	6,639,247	221	170					
Lake Charles, La. (G).....	Firestone Tire & Rubber Co.....	60,000	Sept. 1943	23,060	97	130	14,132,698	236	182					
Port Neches, Tex. (G).....	Firestone Tire & Rubber Co.....	60,000	Nov. 1943	30,860	111	130	16,584,896	276	212					
Baytown, Tex. (G).....	General Tire & Rubber Co.....	30,000	July 1943	27,470	149	130	7,980,548	266	205					
Akron, Ohio (G).....	Goodyear Syn. Rubber Corp.....	30,000	May 1942	35,620	143	130	7,666,247	256	197					
Houston, Tex. (G).....	Goodyear Syn. Rubber Corp.....	60,000	Oct. 1943	17,910	101	130	13,373,698	223	172					
Los Angeles, Calif. (G).....	Goodyear Syn. Rubber Corp.....	60,000	June 1943	22,630	77	130	10,773,701	180	139					
Louisville, Ky. (G).....	National Syn. Rubber Corp.....	30,000	Oct. 1943	22,850	125	130	7,386,853	246	189					
Institute, W. Va. (G).....	United States Rubber Co.....	90,000	Apr. 1943	94,170	136	130	18,560,550	206	158					
Naugatuck, Conn. (G).....	United States Rubber Co.....	30,000	Sept. 1942	25,220	93	100	8,566,247	286	286					
Los Angeles, Calif. (G).....	United States Rubber Co.....	30,000	Oct. 1943	11,590	113	130	5,386,850	180	130					
Total U. S. Gov. Copolymer (G).....		705,000		497,330	...	129	161,902,644	230	178					
Sarnia, Canada (C).....	Canadian Syn. Rubber Ltd.....	30,000			...	...						
Grand total copolymer plants		735,000			...	...						
Miscellaneous, catalyst, chemical and other Buna-S facilities.....					...	...	12,512,609					
Grand total U. S. Gov. Buna-S (G).....		705,000		497,330	...	129	603,798,549	857	663					
Neoprene-GN														
Louisville, Ky. (G).....	E. I. duPont de Nemours & Co.....	54,000	Oct. 1942	50,120	126	111	48,000,000	706	717					
Desmarest, N. J. (P).....	E. I. duPont de Nemours & Co.....	9,000			...	...						
Grand total neoprene.....		63,000			...	...						
BUTYL														
Baton Rouge, La. (G).....	Standard Oil Co. of Louisiana.....	38,000	Mar. 1943	7,950	41	100	27,000,000	710	710					
Baytown, Tex. (G).....	Humble Oil & Refining Co.....	30,000	Sept. 1944 (Est.)		...	100	26,000,000	867	867					
Total U. S. Gov. butyl (G).....		68,000		7,950	...	100	53,000,000	779	779					
Sarnia, Canada (C).....	Imperial Oil, Ltd.....	7,000			...	...						
Grand total butyl.....		75,000			...	...						
ALL U. S. GOV. SYNTHETIC RUBBER														
		827,000		555,400	...	125	699,798,549	845	675					

1, 2, 3. See footnotes preceding page. 4, 4,200 Reserve Co. Actual rated plant capacity is 10,000 tons per year. 5, Maximum month's production

based on unexpanded capacity of 40,000 long tons per year.

its operator, and the other two, utilizing the Houdry dehydrogenation process, are operated by the Standard Oil Co. of California and Sun Oil Co., respectively. Sufficient experience in stabilized operation has not been obtained on any of these plants to predict ultimate costs. However, preliminary indications are that one or more of the plants will be able to produce butadiene competitively with the butylene dehydrogenation units.

4. Naphtha Cracking Process—The processes based on naphtha give a relatively small weight percent of butadiene (yields of 2½ to 5 percent) and, therefore, their economics involve the evaluation and disposal of a large number of other products. At the present time it does not appear that these processes will be competitive with some of the others except for a very small amount of production for which integrated facilities are available for the utilization of a high percentage of the byproducts.

5. Summary—To summarize, at the present time butadiene from alcohol costs approximately five times as much as butadiene from the low cost butylene dehydrogenation. The cost of butadiene from alcohol will continue to be high as long as the price of alcohol is based largely on the cost of grain. If, in the postwar period, sufficient alcohol can be obtained synthetically from petroleum, or from molasses or other low cost agricultural products, this cost differential will close rapidly and the two processes would be competitive, if the prices of alcohol and butylene were approximately 9½ cents and 6 cents per gallon, respectively, or 15 cents and 13½ cents, respectively. These prices of alcohol are somewhat less than are generally estimated for the postwar market and on the basis of the present calculations it appears that the butylene and butane dehydrogenation plants will be the low cost butadiene producers.

STYRENE

The styrene program as established was built largely around the Dow Chemical Co. process which had been in successful commercial operation for several years. In addition, the Carbide & Carbon Chemicals Corp. used their own process and two plants employed modified Dow systems. On the basis of present experience, it appears that the Dow process will be the low cost producer. These plants have operated very successfully and demonstrated their ability to give considerable over-capacity. Based on the operation of the Dow type plants over the past several months, the styrene costs, exclusive of feed stocks, are listed in Table V. Based on present yields, a nomograph for the cost of styrene is given in Fig. 3 as a function of benzene and ethylene prices. At present ethylene is charged to the low cost styrene plants at 6 cents per pound and benzene at about 16 cents per gallon, resulting in a styrene cost of approximately 6.6 cents per pound. Certain other plants obtain their ethylene by the dehydration of alcohol. This results in an ethylene cost of approximately 30 cents per pound which with 16 cents per gallon benzene produces styrene costing 14 cents per

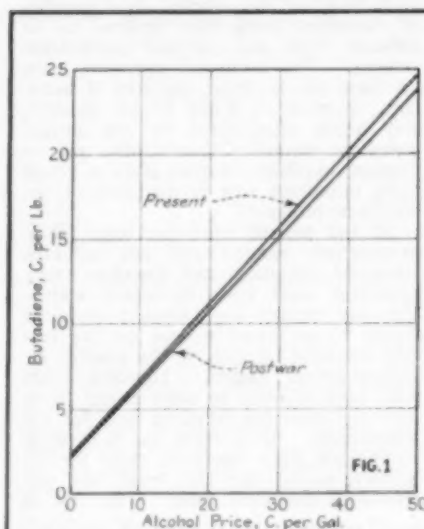


FIG. 1

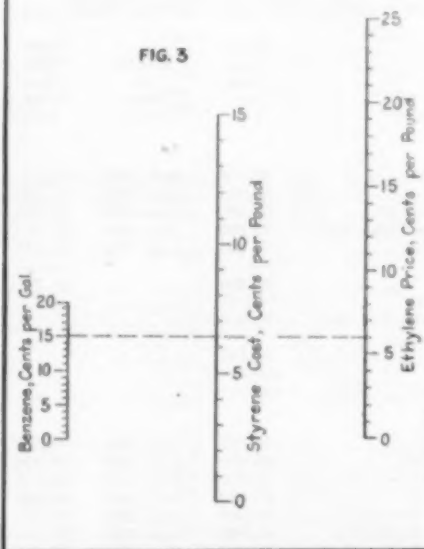


Fig. 3—Estimated direct costs for styrene, present and postwar, excluding amortization; based on typical benzene and ethylene prices

pound. In the postwar picture it has been estimated that ethylene will be available at 2 to 3 cents per pound and benzene at 8 to 12 cents per gallon. Based on these prices it should be possible to produce styrene for an out-of-pocket cost of 4 to 5 cents per pound.

COPOLYMER

With the exception of a few plants which were already engineered and under construction before the expanded Government program was undertaken, the

* Costs based on present and postwar yields of 2.25 and 2.20 lb. of butadiene per gallon respectively.

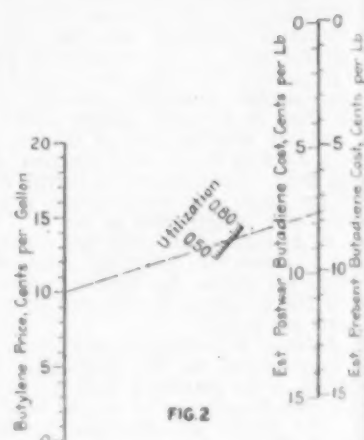


FIG. 2

FIG. 4

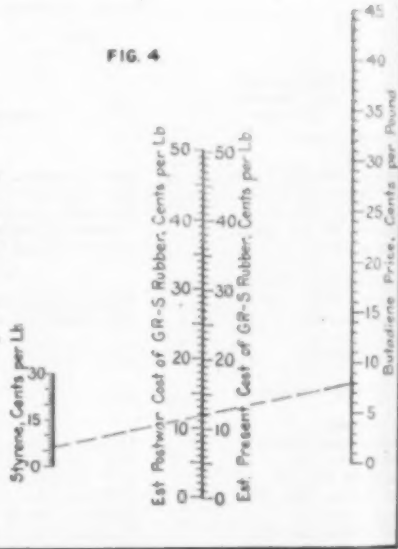


Fig. 2—Estimated direct costs of petroleum butadiene, excluding amortization; based on butylene dehydrogenation, with typical butylene prices and utilization

Fig. 4—Estimated direct production costs for GR-S rubber, excluding amortization; based on typical prices for butadiene and styrene

copolymer plants for the production of Buna-S from butadiene and styrene are primarily of a standard design. In order to provide as nearly a uniform product as possible during the period when the conversion of manufacturing facilities from natural rubber to Buna-S (GR-S) was taking place, every effort was made to run these plants by a standard operating procedure. As a result, the operating costs for the plants once they have attained a full scale operation are quite uniform. A breakdown of these basic operating costs is presented in Table V, together with an estimate of their probable postwar levels. These costs exclude

the cost of the principal monomers, butadiene and styrene. The cost of the Buna-S as a function of the butadiene and styrene cost is presented as a nomograph in Fig. 4. From the nomograph it can be seen that Buna-S can now be produced for an out-of-pocket cost of about 12.2 cents per pound with styrene and butadiene at 7 and 8 cents per pound respectively. (These are the approximate out-of-pocket charges for the present low cost monomer producers). If the butadiene is made from alcohol at present prices, the out-of-pocket cost for Buna-S is approximately 37 cents per pound. On a postwar basis it has been indicated above that it should be possible to produce butadiene and styrene at out-of-pocket costs of not over 7 and 5 cents per pound, respectively. These prices should make it possible to produce Buna-S at an out-of-pocket cost of 10.7 cents per pound. Even if the butadiene cost were 9 cents per pound, as might be realized by the alcohol process, the direct cost of Buna-S would be only 12.1 cents per pound. In all of the above costs, nominal management fees and royalties as listed only are included. The additional selling expenses, provisions for profit, interest charges on the use of private operating capital, increased royalties and market risks may well increase the cost of both the monomers and the Buna-S itself by several cents a pound, probably not less than 2 nor more than 4 cents per pound. However, no attempt was made to include these in the above studies.

SHIPPING COSTS

Of general interest are a few calculations on the over-all operation from the raw materials at their source to finished rubber laid down in Akron. In Table VI are presented estimates of the postwar cost for three cases. The first involves making the styrene, butadiene and Buna-S

Table V—Butadiene, Styrene and Copolymer Plant Operating Costs
(Cents per Pound of Product Excluding Feed Stocks, Amortization, Preliminary Expense, Research)

	Butadiene		From Butylene (Dehydrogenation)		Styrene		Copolymer	
	From Alcohol	Post-war	Present	Post-war	Present	Post-war	Present	Post-war
Chemicals (excluding feedstocks)	0.18	0.13	0.57	0.50	0.43	0.42	2.10	1.90
Utilities	0.95	0.75	1.20	1.20	0.46	0.46	0.26	0.26
Other costs:								
(a) Operating labor	0.14	0.12	0.45	0.44	0.27	0.25	0.52	0.45
(b) Supervision	0.02	0.02	0.07	0.07	0.06	0.06	0.05	0.05
(c) Repairs and maintenance	0.19	0.30	0.62	0.60	0.23	0.30	0.40	0.40
(d) Operating supplies	0.04	0.03	0.15	0.15	0.01	0.01	0.02	0.02
(e) Laboratory	0.04	0.03	0.25	0.25	0.05	0.05	0.10	0.10
(f) Packaging and shipping	0.01	0.01	0.02	0.02	0.01	0.01	0.33	0.25
(g) Plant overhead			0.20	0.20				
(1) Salaries, wages			0.20	0.20	0.16	0.15	0.33	0.30
(2) Insurance	0.02	0.02	0.06	0.06	0.03	0.03	0.03	0.03
(3) Taxes	0.02	0.02	0.01	0.01	0.01	0.01	0.08	0.08
(4) Miscellaneous	0.32	0.27	0.15	0.15	0.27	0.27	0.09	0.09
Sub-total other costs	0.80	0.82	2.21	2.15	1.10	1.14	1.95	1.77
Royalties and management*	0.51	0.63	0.65	0.63	0.68	0.63	0.52	0.51
Total	2.44	2.33	4.63	4.48	2.66	2.65	4.83	4.44
Byproduct credit	-0.23	-0.14			-0.14	-0.14		
Total out-of-pocket	2.21	2.19	4.63	4.48	2.52	2.51	4.83	4.44

* Management fee is scaled down with increased yearly production in a uniform manner for all producers.

in Texas and shipping the finished rubber to Akron; the second involves starting with 5½ cents styrene at Institute, West Virginia, making the butadiene from alcohol and the Buna-S at Institute and shipping the finished rubber to Akron. The third involves the manufacture of the styrene and butadiene in Texas and shipment to Akron for polymerization.

NATURAL RUBBER COSTS

(Editor's Note—The following is taken from a supplementary report, appearing as an appendix in the Special Report on the Synthetic Rubber program which is reproduced on the preceding pages. The appendix was prepared at the request of the Rubber Director by Everett G. Holt, chief of the commercial research division of the Rubber Development Corp., and formerly chief of the rubber division of the U. S. Department of Commerce. Those with more than a casual interest in prewar natural rubber production costs and prices in the United States should refer to the original appendix, since it is a 14-page condensation of an extremely thorough study.)

The grade for which prices are quoted here is "plantation ribbed smoked sheets," prices for which are above the average for

all grades of rubber. So far as rubber users in the United States are concerned, perhaps the best index is the series of prices at which rubber has sold in the New York market. Such prices do not, however, necessarily reflect the long-term trend in cost of rubber production at the plantations, and hence give no good idea of possible postwar prices in the face of strong competition from synthetic rubber. (The appendix goes at considerable length into plantation costs of production and also indicates the nature of improvements that were being instituted in prewar years at the plantations and discusses the possibility for further cost lowering.—Editor).

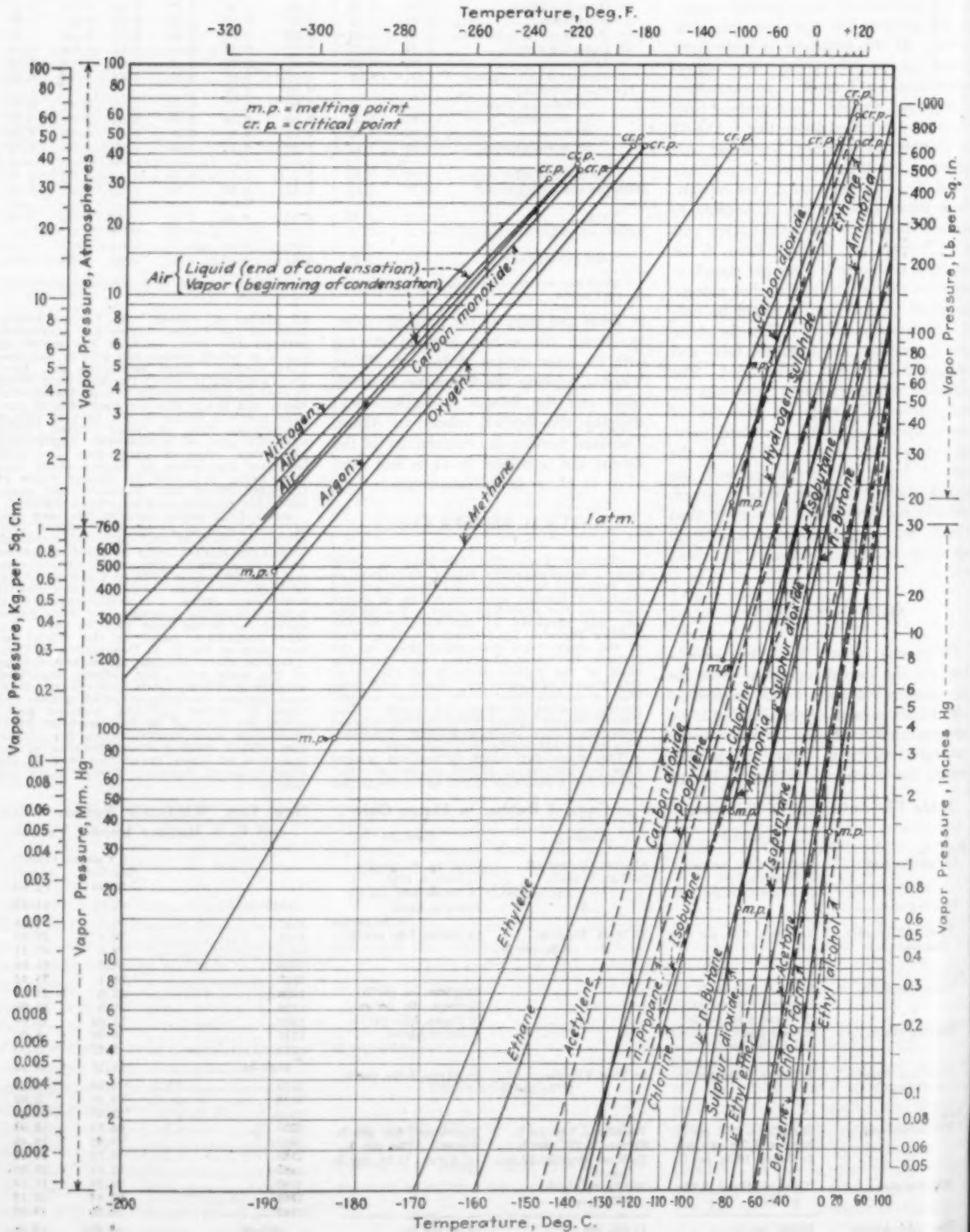
Since 1922 rubber trading has been free of the effects of government control over production only in 1929-1933. The average New York market price during that period was 9.63 c. per lb., the annual price declining from 20.6 c. in 1929 to a low of 3.47 c. in 1932. The latter, however, was strictly a depression price. The accompanying tabulation shows the average New York prices during the period from 1923 to 1941. Another indication, based on the official import data of the U. S. Department of Commerce is given also in the second column of the same table, and reflects importers' average laid-down costs accurately. However, import statistics cover all grades and types of rubber and the declared prices would be expected to be somewhat lower than New York market prices for plantation ribbed smoked sheets because of the inclusion of lower grades, as well as the elimination of domestic trading costs and profits.

New York Wholesale Rubber Prices and U. S. Rubber Import Values

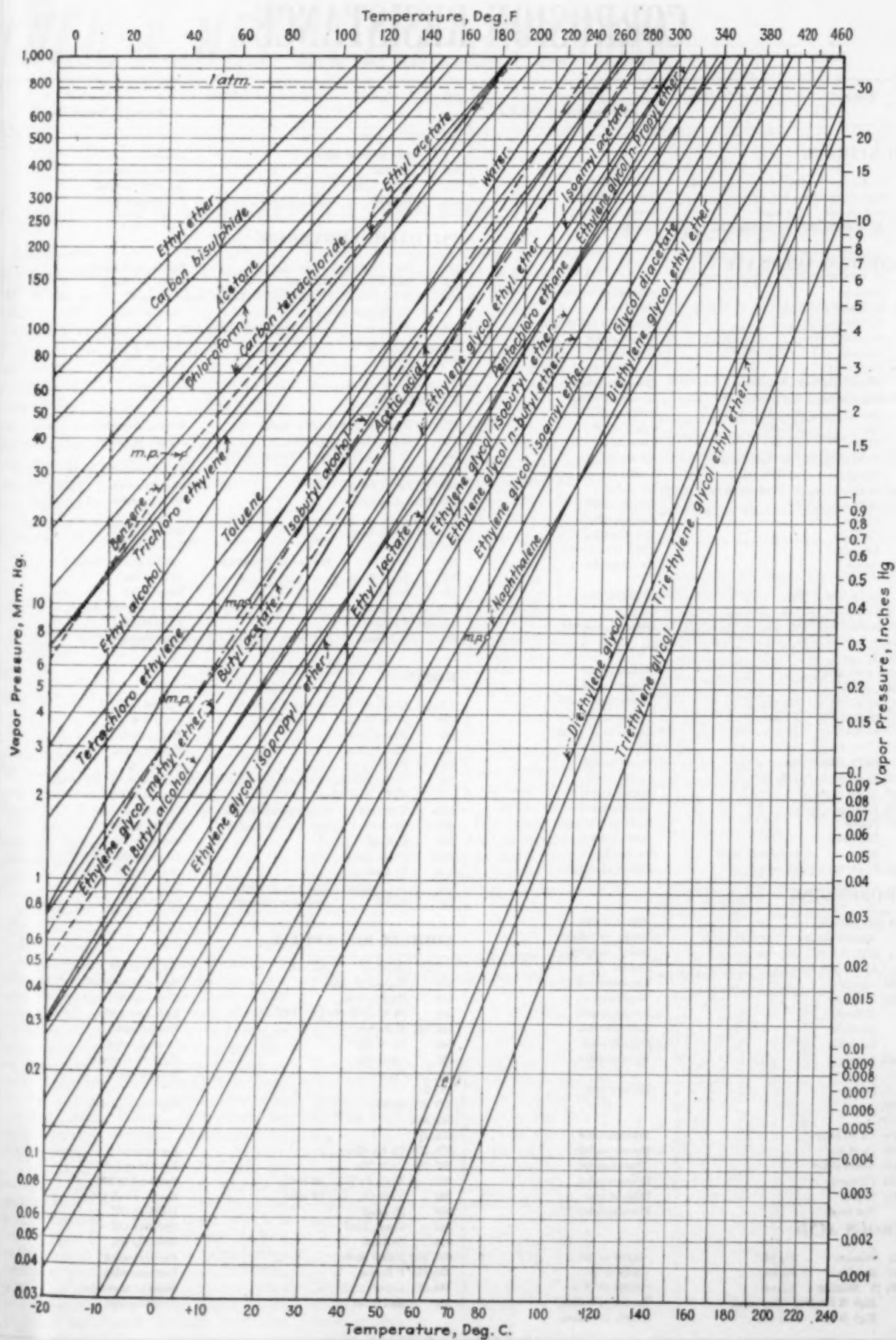
Table VI—Influence of Shipping Costs on Costs of Rubber in Akron, Ohio

	Case I	Case II	Case III
Butadiene:			
Production cost.....	Butylene, 6c. per gal. Utilization, 0.65 In Texas, 6.6c. per gal.	Alcohol, 15c. per gal. In West Virginia, 8.8c. per gal.	Butylene, 6c. per gal. Utilization, 0.65 In Texas, 6.6c. per lb. Texas to Akron 0.9c. per lb.
Shipping cost.....	0	0	0
Total c.i.f. copolymer plant	In Texas, 6.6c. per lb.	In West Virginia, 8.8c. per lb.	In Akron, 7.4c. per lb.
Styrene:			
Production cost.....	Ethylene, 3c. per lb. Benzene, 10c. per gal. In Texas, 4.8c. per lb.		Ethylene, 3c. per lb. Benzene, 10c. per gal. In Texas, 4.8c. per lb.
Shipping cost.....	Styrene plant, Texas, to copolymer plant, Texas, 0.15c. per lb.		Texas to Akron, 0.95c. per lb.
Total c.i.f. copolymer plant	In Texas, 4.95c. per lb.	In West Virginia, 5.75c. per lb.	In Akron, 5.75c. per lb.
Buna-S:			
Production cost.....	Butadiene, 6.6c. per lb. Styrene, 4.50c. per lb. In Texas, 10.3c. per lb.	Butadiene, 8.8c. per lb. Styrene, 5.75c. per lb. In West Virginia, 12.1c. per lb.	Butadiene 7.40c. per lb. Styrene, 5.75c. per lb. In Akron, 11.1c. per lb.
Shipping cost.....	Texas to Akron, 0.75c. per lb.	W. Va. to Akron, 3.33c. per lb.	0
Total c.i.f. Akron....	11.05c. per lb.	12.43c. per lb.	11.1c. per lb.

Vapor Pressures of Various Materials



Vapor Pressure, inches Hg
Vapor Pressure, lb. per Sq. In.



CORROSION RESISTANCE

(Continued from Chem. & Met., Sept. 1944, p. 130)

No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)
LEAD NITRATE				PHTHALIC ANHYDRIDE			
2-11	Stainless	Sat. sol.	<0.004 at 70°	308	All Cu—Base Alloys	Attacked	
139	High Si Mo Iron	Any conc.	Recom. to boiling	311	Sb Lead	Not recommended	
142	High Si Iron	Any conc.	Recom. to boiling	314	Chem. Lead	Not recommended	
209	Fe Ni Cr Si Mo Cu	Aqueous sol.	<0.001 at 176°		Te Lead	Not recommended	
MAGNESIUM SULPHATE				PYRIDINE			
2-11	Stainless		<0.0042 at hot or cold	139	High Si Mo Iron	Any conc.	Recom. to boiling
12, 15, 18	Stainless		<0.04 at hot	142	High Si Iron	Any conc.	Recom. to boiling
19	Stainless		<0.0042 at hot or cold	209	Fe Ni Cr Si Mo Cu	Phthalic acid slurry with maleic acid	OK at 180°
20	Stainless		<0.004 at hot		All Cu—Base Alloys	Recommended	
25	Stainless		<0.004 at 70°	302	Ni Cr Fe	In processing tank during mfr.	<0.001 at 390°
104	Fe Ni Cu Cr		No attack	316	Ni Cu Alloy		Same as 302
139	High Si Mo Iron	Any conc.	Recom. to boiling	330	Nickel		Same as 302
142	High Si Iron	Any conc.	Recom. to boiling	ROSIN			
187	Steel	5% sol. ¹	0.0022 at 68°	2-25	Stainless	Molten	<0.004
189	Steel	5% sol. ¹	0.0023 at 68°	104	Fe Ni Cu Cr		No attack
190	Ni Steel	5% sol. ¹	0.0018 at 68°	139	High Si Mo Iron		Recommended
209	Fe Ni Cr Si Mo Cu	Acid slurry	<0.001 at 176°	142	High Si Iron		Recommended
213	Aluminum	0.1-10% sol.	<0.001 at room temp.	176	Fe Ni Cu Cr		0.01 at 700°
214-222	Al Alloys	All Al alloys expected to be same as 213.		209	Fe Ni Cr Si Mo Cu	Rosin + fatty acid in black liq. recovery	OK at 350°
244, 247	Al Bronze		Recommended		All Cu—Base Alloys	Recommended	
248	Al Brass		Recommended	213	Aluminum	In processing of rosin	Used in industry
249	Cu Ni Zn		Recommended	302	Ni Cr Fe	Pine gum distillation	<0.001 at 212°
257	Admiralty		Slight to moderate	308	Sb Lead		Probably OK
259, 262	Copper		Recommended	311	Chem. Lead		Probably OK
266, 277				314	Te Lead		Probably OK
268	Ni Cr Alloy	Sol. ¹	Recommended	316	Ni Cu Alloy	Pine gum distillation	0.005 at 212°
272, 273	Brass		Slight to moderate	330	Nickel	Pine gum distillation	0.012 at 212°
315, 343				SODIUM BISULPHITE			
344, 372				2-11	Stainless	Sat. sol.	<0.004 at 70°
275, 276	Cu Ni Alloy		Recommended	139	High Si Mo Iron		Not recommended
283-285	Cu Si Mn		Recommended	142	High Si Iron		Not recommended
290, 291	Ni Mo Fe	All conc.	Recom. at all temp.	209	Fe Ni Cr Si Mo Cu	10% sol.	No loss at 176°
293	Ni Cr Fe W	All conc.	Recom. at all temp.	244, 247	Al Bronze		Recommended
293	Ni Si Cu	All conc.	Recom. at all temp.	249	Cu Ni Zn		Recommended
299	Ni Cr Alloy	Sol. ¹	Recommended	257	Admiralty		Slight to moderate
332	Ni Cr Alloy	Sol. ¹	Recommended	259, 262	Copper		Recommended
335, 336	Ni Cr Steel	10% sol. ¹	<0.004 at 68°	266, 277			
337, 338	Nickel Silver		Recommended	272, 273	Brass		Slight to moderate
350-353	P Bronze		Recommended	315, 343			
355, 371	Copper		Slight to moderate	344, 372			
359	Red Brass		Recommended	275, 276	Cu Ni Alloy		Recommended
364	Silver	In dyestuff plant	No attack	283-285	Cu Si Mn		Recommended
366-368	Co Cr W	All conc.	Recom. at all temp.	292	Ni Cr Fe W	All conc.	Preferred to 293
NITROBENZENE				293	Ni Si Cu	All conc.	Recom. at all temp.
9, 10, 25	Stainless		<0.004 at 70°	308	Sb Lead		Probably OK
139	High Si Mo Iron	Any conc.	Recom. to boiling	311	Chem. Lead		Probably OK
142	High Si Iron	Any conc.	Recom. to boiling	314	Te Lead		Probably OK
209	Fe Ni Cr Si Mo Cu		No loss	337, 338	Nickel Silver		Recommended
211, 258	Admiralty		Recommended	350-353	P Bronze		Recommended
244, 247	Al Bronze		Recommended	355, 371	Copper		Slight to moderate
248	Al Brass		Recommended	359	Red Brass		Recommended
249	Cu Ni Zn		Recommended	NITROUS ACID			
257	Admiralty		Little or none	2-12	Stainless	8% sol.	<0.004 at 70°
259, 262	Copper		Recommended	15, 18	Stainless	8% sol.	<0.04 at 70°
266, 277				19, 20, 25	Stainless	8% sol.	<0.004 at 70°
272, 273	Brass		Little or none	139	High Si Mo Iron	Any conc.	Recom. to boiling
315, 343				142	High Si Iron	Any conc.	Recom. to boiling
344, 372							
275, 276	Cu Ni Alloy		Recommended				
283-285	Cu Si Mn		Recommended				
337, 338	Nickel Silver		Recommended				
350-353	P Bronze		Recommended				
355, 371	Copper		Little or none				
359	Red Brass		Recommended				

CHEM. & MET. PLANT NOTEBOOK

THEODORE R. OLIVE, Associate Editor

\$50 WAR BOND FOR A GOOD IDEA

Until further notice the editors of *Chem. & Met.* will award a \$50 Series E War Bond each month to the author of the best short article received during the preceding month and accepted for publication in the "Chem. & Met. Plant Notebook." Articles will be judged during the month following receipt, and the award announced in the issue of that month. The judges will be the editors of *Chem. & Met.* Non-winning articles submitted for this contest may be published if acceptable, and if published will be paid for at space rates applying to this department.

Any reader of *Chem. & Met.*, other than a McGraw-Hill employee, may submit as

many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are criteria of the judging.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address entries to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

August Contest Prize Winner

LINING FLOTATION CELLS WITH MAPLE FLOORING SOLVES A DIFFICULT CORROSION PROBLEM

L. D. ANDERSON

Consulting Engineer
Potash Co. of America
Carlsbad, N. M.

CORROSION is one of the most important problems with which the chemical engineer has to contend. There are many corrosion resistant materials available, whose use is often imperative. In general, however, they are expensive. An effective defense against corrosion which was found relatively inexpensive may, therefore, be of interest to fellow engineers.

In a certain plant in which potassium chloride is separated from sodium chloride by flotation in a saturated brine of the two, there was much trouble from corrosion of steel plate equipment. The flotation cells were originally lined with rubber. The bond of the rubber to the steel plate did not prove effective under the conditions of agitation of a brine pulp, the rubber tearing loose and causing endless trouble by choking pipe lines and pumps. It was then decided to line the flotation cells with matched maple flooring, whereupon no further trouble has been experienced for several years.

This maple lining is not absolutely water tight. Some brine does get between it and the steel plate. Corrosion of the plate begins, forming a sort of crust, which is kept in place by the maple lining. As long as this crust is held tightly in place further corrosion proceeds very slowly, the steel plates thus protected having already lasted several times as long as the original ones. It is not anticipated that the protection will be absolutely permanent but it is be-

lieved that the extended life obtained by this expedient is well worth while.

The same principle applies to other kinds of lining, such as brick, in tanks subject to corrosion. They need not be absolutely tight. All that is necessary is that they retain firmly in place the crust, or scale, of the original corrosion, whereupon further corrosion will proceed quite slowly.

ROTAMETER CONVERSION CHART FOR GAS WEIGHTS AND VOLUMES

D. S. DAVIS
Wyandotte Chemicals Corp.
Wyandotte, Mich.

IN CONNECTION with the use of Stabl-Vis and Ultra-Stabl-Vis rotameters for gases, indicated weight and volume rates of flow must be multiplied by the factors C_w and C_v , respectively, when a gas other than that employed in the calibration is being measured. When the pressures and temperatures of the two gases are the same the factors can be calculated from the expressions¹

$$C_w = \left(\frac{\sigma_a}{\sigma_b} \right)^{0.5} \text{ and } C_v = \left(\frac{\sigma_a}{\sigma_b} \right)^{0.5}$$

where σ_a = density of the gas used in the calibration and σ_b = density of the gas being metered.

The use of the nomograph, which facili-

SEPTEMBER WINNER

A \$50 Series E War Bond
will be issued in the name of

ALFRED H. MCKINNEY

Chemical Department
Philadelphia Quartz Co.
Philadelphia, Pa.

For an article dealing with a
means of using a temperature
recorder to measure flow rate
which has been adjudged the
winner of our September contest

This article will appear in our
November issue. Watch for it!

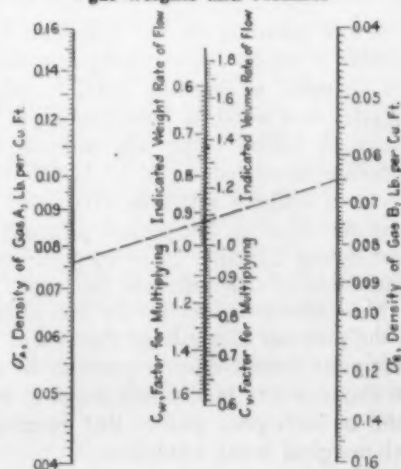
tates solution of these equations, is illustrated as follows: What are the weight and volume factors when measuring the rate of flow of a gas having a density of 0.065 lb. per cubic foot when the gas used in the calibration had a density of 0.076 lb. per cubic foot? Connect 0.076 on the σ_a scale with 0.065 on the σ_b scale and read the weight and volume factors on the C_w and C_v scales as 0.925 and 1.08, respectively.

The chart, constructed by methods described previously,² can also be used with rotameters equipped with plumb-bob floats if the viscosities of the two gases are substantially the same.

REFERENCES

1. "Theory of the Rotameter", Sec. 80-A, Fischer & Porter Co., Hathboro, Pa.
2. Davis, D. S., "Empirical Equations and Nomography", p. 104, 1st ed., McGraw-Hill Book Co. Inc., New York, 1943.

Rotameter conversion nomograph for
gas weights and volumes



FROM THE VIEWPOINT OF THE EDITORS—

S. D. KIRKPATRICK, Editor • JAMES A. LEE, Managing Editor • THEODORE R. OLIVE, Associate Editor • HENRY M. BATTERS, Market Editor
J. R. CALLAHAM, Assistant Editor • L. B. POPE, Assistant Editor • R. S. MCBRIDE, Consulting Editor

"MUST" LIST CHANGES

FOR THE Japanese war, there is an entirely new "must" program. At the first of October this list included "heavy trucks and heavy tires, heavy artillery and ammunition, radar equipment, tanks, forge and foundry products, ships and ship repairing equipment, tentage fabric, lumber and pulpwood, construction equipment and other items of secret character." And, on our own, we can add medicinals, insecticides and insect repellants, as well as all the chemicals that enter into all of the foregoing.

Almost any chemical engineer is competent to appraise this list as it affects the use of materials and services and thus gage the demand for his skills and those of his company. Such an appraisal is important. But what about the time schedule? Extensive discussion of this question with a number of well informed gentlemen in Washington seems to indicate the following as a safe and proper plan of action.

We must assume that the Japanese war will go on for at least a whole year. (If it does not, so much the better.) We may assume that further manufacturing for German victory will not be required here next year even though the field campaign may, and certainly the occupation in Germany will, continue for all of 1945.

The "must" list quoted above indicates the portion of our manufacturing job which will be most emphasized from now until the first of 1945. There will then be a tapering off on the portion of this activity which has least significance in Pacific fighting. The cutback from peak production of 1944 will be pretty well accomplished by July 1—the general estimate being about 40 percent of total military needs. There will be no cutback on Pacific needed equipment until we are very close to the end of that job.

MORE WASTE WOOD FOR ENGINEERS

POSTWAR planning for the American forest industries, a number of which are becoming increasingly important in the chemical engineering field, is important. Growth supplies new wood in American forests to the extent of about 11 billion cubic feet annually, but the drain is variously estimated from 17 to 21 billion cubic feet. There is nothing alarming about this situation for the next decade or so, but present planning is needed to prevent serious difficulty 20 to 40 years from now when the magnitude of demands will be larger.

Most obvious corrective for this exhaustion of reserves is the proposal that a larger forest area be developed and that more intensive forest practices be applied. There is an abundance of land which ought to be put into forests, land of such poor quality that farming on it results in sub-marginal living conditions.

Most important chemical engineering aspect of the whole problem appears to lie in the fields of more complete utilization and of development of new processes for using what are now waste parts or varieties of cuts. The whole product from a given cut-over area could readily be developed if these two types of technological effort were made. The forest effort, made largely by the lumbering industry in cooperation with the Government, would aim to make it feasible financially to bring out for use a larger portion of the timber cut. This would insure a continuous supply of relatively low-cost forest raw materials for chemical processing, thus greatly stimulating new methods of utilization as well as a more intensive commercialization of present processes.

POSTWAR MILITARY RESEARCH

UNCLE SAM has sponsored more research dollar-wise during the last few years than in all previous history. Plans for the postwar termination of research projects and the proper continuance of certain long-time undertakings is now of major concern to Washington research leaders. Much of interest to chemical engineers is involved in the crystallization of these plans for postwar research.

When Japan has fallen there will no longer be need for continuance in their present form of either OSRD or OPRD. These two agencies have proved their value in the war period; but they are not set up for peacetime operation in their present form. It is very gratifying to learn, therefore, that already the Army and Navy Committee, which is advising the Secretaries with regard to future military research, has taken account of this fact and is seeking to place properly the parts of these and other governmental agencies which are of postwar significance.

In making these arrangements, which will require Congressional approval ultimately by appropriation, it is hoped that able and experienced leadership can be provided by the military services. Apparently the military men now recognize the difference between competent and inspiring professional civilian research and the subsequent development work which only the trained military man can fully guide as attempt is made to translate into field conditions the results of civilian research. Only through clear distinction will the best results be available to the military services for application by the uniformed organizations afloat, on land, and in the air.

Equally important, and equally neglected in the past, are those important researches which will be applied by industry for the benefit of the military. The Quartermaster Corps, Ordnance and other supply services can get what they need from industry with greatest economy and most prompt delivery if the government itself has investigators capable of working with industry on a pro-

fessional basis. The results that such governmental investigations will achieve will find development in the manufacturing establishments of the nation.

The uniformed staffs will not get the commodity results directly from their own laboratories; but they will get them in the products of manufacture which they buy. The Services will remain the ultimate judge of the usefulness of the product, while the research is done in the fundamental laboratories and the manufacturing development is done by industry. Advice of the commissioned officers is essential at all stages, lest the ultimate objective be lost from view; but the techniques are those of civilian research.

We trust that the men of high standing and long experience who are advising the Secretaries of War and Navy will succeed in properly organizing effective plans for postwar research. Wisdom is surely needed as insurance against the recurrence of ignorance in time of emergency.

CURRENT FASHIONS IN RESEARCH

TEXTILE industries have not gone in for fundamental research. Of late, however, the executives and technical leaders of these industries have become keenly conscious of the need of more research, both fundamental and practical in nature. Like religion, this is a good thing, but too sudden conversion also has its hazards.

At least five important institutions have lately announced the establishment of research agencies or programs for scientific and technological work of this character. There is room enough for the work of all, and for other institutions that have not yet announced plans. But there is a grave question as to whether there are enough qualified leaders to guide and workers to do the investigations which are being contemplated as the "research fashion" has taken hold so suddenly in this industry. There will be need for great wisdom in the guidance of these establishments.

This should be a matter of concern, both within and without the textile industries. If these institutions do a good job, the industries, the scientific and engineering professions, and the general public will all benefit. If even one or two undertakings should fail, there is a grave danger that research may fall into disrepute with some parts of the industries. Let us hope that this does not occur.

There is no group of American industries that could profit more from the methods and applications of modern science. Cautious development of research programs will, we can hope, make all of these and other undertakings constructive and prevent any of them from becoming discouraging failures.

COTTON vs. RAYON

Those interested in cotton for the well-being of the Southeastern states are now confronted with a new variety of inter-commodity competition. This was splendidly pointed out for the guidance of all cotton interests recently in a discussion before the Annual Cotton Research Congress at Dallas, Texas. On that occasion R. J. Cheatham of the Southern Regional Laboratory indicated the significance of using staple rayon in cotton-

mill machinery. He pointed out that these mills use cotton by tradition and experience. But "they can now use rayon staple fibre also and are likely to do so if profits are greater." That is a fair statement of a natural and inevitable human trait.

It was pointed out that staple rayon of desirable lengths sells at 25 cents a pound, as compared with 22 cents for short staple cotton. However, when one takes account of the differences in tare and differences in market demand for yarn and fiber there is actually little difference per pound between the two fibers. In fact, there is some evidence of a greater profit to the mill companies if they spin and weave rayon instead of cotton.

It appears that the chemical process industries have advanced rayon technology to the point that the only safe thing for cotton is now to grow and supply a satisfactory high grade cotton at a lower cost per pound at the mill. Southern agriculture must note and act on this trend in the textile industries. It can be taken for granted that the rayon industry is not yet done with its development and cost improvement programs.

WALTER SAVAGE LANDIS, 1881-1944

WE SAT ACROSS AN N.A.M. Committee table from him on Wednesday, September 13. There was a job to be done, a sub-committee to be appointed, and it was only natural that Chairman Weidlein should immediately select Dr. Walter S. Landis for the assignment. Two days later the hurricane that swept up the Atlantic Coast snuffed out the life of our dear and willing friend. When warnings came on Thursday, he had hurried to his home in Stamford to do what he could to prevent a repetition of the disastrous damage that had resulted from the 1938 storm. He over-exerted himself and a few hours later his great but ailing heart ceased to beat. He died as he chose to live—working tirelessly and unselfishly.

That, as we think back over a quarter of a century of fairly intimate contact with Walter Landis, was his outstanding characteristic. His abundant energy combined with his willingness to help any time, anywhere, in any worthwhile enterprise—was what made him such a productive leader of the chemical profession. There was never a job to be done that he declined to do if convinced that it was needed and would be helpful. In the dark days of the depression his energies, along with those of a few others, carried along the vital relief work of the Chemists Advisory Committee. His close studies of the economics of chemical industry in this country and abroad were willingly shared with important groups and associations in almost every field of American business. The same was true of the realistic knowledge of research which he had gained through thirty-five years of active participation and direction. Landis' energy and "know-how" were always ready and available when needed.

Thus it is that so many of us already feel such a great loss in his passing. His achievements were recognized by the many medals and honors awarded him by the various scientific and professional societies. His leadership was recognized, not only in his own company, but in literally scores of boards of directors, industry committees, business and technical organizations. But what we miss most is the inspiration of his energetic example in serving others with no thought of self.

PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

WATER SEPARATOR

AUTOMATIC separation of water from compressed air and gases, and simultaneous ejection from the line, without the use of moving parts, is the function of a new family of "Liqui-jectors" recently announced by the Selas Corp. of America, Erie Ave. at D St., Philadelphia 34, Pa. This result is accomplished by means of a recently discovered method for automatically separating liquid and gas phases by virtue of the surface tension of the liquid.

The active elements in this continuous and automatic performance are two porous ceramic tubes, one inherently water repellent, the other water permeable, but air impervious. The device has already gone through a period of field development and has found use in connection with air-actuated industrial instruments, spray and blast equipment, compressors, atmosphere gas generators, and pneumatic tools. The device is adaptable for air and gas lines up to 14-in. pipe size and normal line pressures.

Air enters the connection shown at the upper right in the accompanying illustration, leaving through the upper left connection. In doing so it passes through the upper (water repellent) tube, where it is stripped of liquid water in the form of droplets, slugs or mist. This tube is a coarse ceramic, having an average of 50,000 pore openings per square inch, each so small that the pressure drop across the tube is insufficient to permit water passage against the resisting diaphragm-action of its surface tension. The moisture therefore coalesces and drops to the bottom of the unit where it passes through the second tube to the outside atmosphere. This second tube is constructed of a micro-porous porcelain with an average of 720,000,000 pore openings per square inch which, being constantly wet by its wick action, is said to constitute a perfect air seal up to the rated limit working pressure of the unit.

In the unit shown, which is the smallest size designated as Model A-150-1 for 1-in. pipe lines at pressures up to 100 lb. per sq. in., the pressure drop is less than 0.5 lb. at 65 lb. per sq. in., with a throughput of 5 cu. ft. per min. The liquid ejection rate is said to be high enough so that even an abnormal moisture content can be handled readily.

KARBATE HEAT EXCHANGER

A PLATE-TYPE heat exchanger, employing the principle of extended surface achieved through corrugations, has been perfected in Karbate by the National Carbon Co., Cleveland, Ohio. Karbate, a chemically inert graphitic material, pos-

sesses a high heat transfer rate and is said to be resistant to practically all acids, alkalis and solvents. The material is furthermore unaffected by acute thermal shock and can be used freely in intermittent operation or in alternately hot and cold baths, according to the manufacturer. The new construction assures maximum heat transfer area within a small overall size, as is evident from the accompanying illustration. This factor reduces the tank space required for the heater, further minimizing the hazard of mechanical shock during processing operations. The heater shown in the illustration is a 4-in. thick plate with a number of internal 1 1/2 in. diameter communicating passages for steam or cooling medium. Heaters may be installed in sections, depending on tank capacity or solution temperatures required. Several such heaters, 4x10x18 in. in size, operating on 25-lb. steam pressure and maintaining tank temperatures of 180 to 190 deg. F., have been in service for a year or more, operating on a mixture containing approximately 10 percent nitric and 3 percent hydrofluoric acid in tanks measuring 3x4x4 ft. There is said to have been no visible sign of deterioration in this time. No metal heat exchanger has been found to stand up in the same application more than a few days.

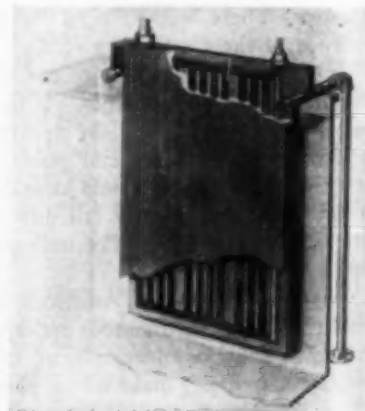
SLUDGE COLLECTOR

FOR USE in smaller diameter settling tanks, up to 55 ft. in diameter, the Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa., has announced the Type B Circulinc collector, supplementing the Type A for larger tanks, up to 115 ft. in diameter. With this collector the settled sludge is collected and continuously moved radially inward, on the tank floor, by a slow-moving scraper flight type conveyor and sludge plow, into a sludge hop-

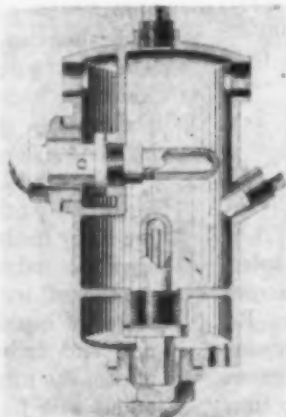
per centrally located, from which the sludge is withdrawn. The conveyor is mounted on a power-rotated, centrally pivoted bridge spanning half the diameter of the tank and having anti-friction-bearing-equipped, resilient, rubber-tired wheels at the outer end of the span, for smooth, easy travel on the top of the tank wall. The entire floor area of the tank is cleaned of settled solids during each complete revolution of the bridge, permitting very slow rotation and insuring a minimum of disturbance to the settling process and the settled solids.

Influent is introduced centrally through a conduit under the floor of the tank, with effluent withdrawn over a peripheral weir. The drive, located at the outer end of the bridge span, consists of a motorized speed reducer carrying a sprocket wheel which engages a heavy galvanized tow chain located and anchored in the effluent trough. The outer end of the bridge is pulled by this chain, or it might be said to "walk around" the chain. When used in a primary settling tank, the collector is provided with a screw conveyor supported along one side of the bridge span, for the purpose of confining and more effectively moving the scum

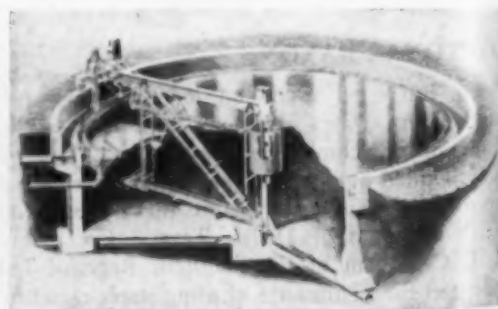
New Karbate plate type heat exchanger



Cross-section of new Liqui-jector



Type B settling tank collector





Fan-cooled speed reducer



New Cover-Lite goggle

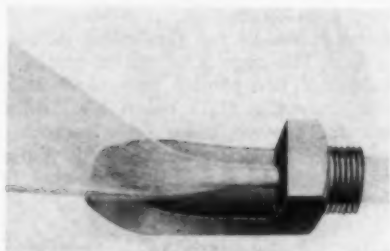
and grease to a scum trap. It is claimed that this feature prevents wind pressure from blowing the collected scum out of reach.

FAN-COOLED REDUCER

PRONOUNCED reduction in size for a given power output is achieved in the new Speedaire worm gear reduction unit recently announced by Cleveland Worm & Gear Co., 3249 East 80th St., Cleveland 4, Ohio. This is the result of incorporating a fan-cooling system into the unit. The basis of the cooling system is a new type of double-wall construction which provides an air passage completely enveloping the oil reservoir in which the gear operates. The inner housing wall forming the oil reservoir is deeply finned on the air side. An exhaust fan located on the coupling end of the worm shaft draws air at high velocity through the space between the housing walls. The fan is designed to operate with either direction of rotation. This system is said to reduce operating temperature greatly, giving the unit a much greater load-carrying capacity than a standard worm gear unit of equal size, when operated at usual motor speeds. In many instances, according to the manufacturer, it is possible to obtain an operating capacity with units of the new type equal to that of standard worm gear units having approximately double the housing dimensions. This results in an advantage due to reduced size or weight, as well as a material reduction in the dollar cost per horsepower transmitted.



New revolving-field generator



New flat-spray nozzle

PLASTIC GOGGLES

WEIGHING less than 1 ounce, a new all-plastic goggle has been introduced by the Chicago Eye Shield Co., 2300 Warren Boulevard, Chicago, Ill., under the name of Cover-Lite. This goggle is designed to fit varying facial widths and may be worn directly over prescription glasses, as shown in the accompanying illustration. The large air space is said to eliminate fogging, while the strong plastic frame not only protects the entire eye area, but also shields against distracting reflections and eye strain, according to the manufacturer. In case of lens breakage, replacement of the broken lens is simple, a new lens being snapped into place readily.

REVOLVING-FIELD GENERATOR

SIZES from 5 to 25 kw. at 1,800 r.p.m. (and from 5 to 15 kw. at 1,200 r.p.m.) are available in a new line of revolving-field generators manufactured by Kato Engineering Co., Mankato, Minn. These generators are built both as independent two-bearing generators for belt or coupling drive and as single-bearing generators for direct attachment to a standard engine bell housing. The generators are conservatively rated and will carry 25 percent overload without exceeding the allowable temperature rise, according to the manufacturer. The voltage regulation is approximately 10 percent with a two-cycle speed change. Generators are made in all standard voltages and frequencies.

FLAT-SPRAY NOZZLE

FOR A VARIETY of spraying applications where a sharp, flat, hard-hitting spray is needed, Spraying Systems Co., 4023 West Lake St., Chicago 24, Ill., has introduced the "Flatjet" spray nozzle shown in an accompanying illustration. The nozzle is built without cores, vanes or other obstructions, depending solely on its jet and deflector plate to produce the desired spray pattern. Standard nozzles are made of brass, steel or stainless steel, in one-piece construction. Nozzles may also be made



New 8-in. high-capacity diffusion pump

of other materials, if desired. The nozzle delivers a flat spray with sharply defined edges and uniform distribution, requiring that all surfaces coming in contact with the liquid spray be accurately machined. A wide range of sizes is available for all requirements. Such nozzles may be used with water, brine, oil and liquids of similar viscosity.

DIFFUSION PUMP

CAPACITIES in the neighborhood of 2,500 cu. ft. of free air per minute in the pressure range of 0.1 to 0.01 microns are possible with the new Type B-8-0 industrial high vacuum diffusion pump announced by National Research Corp., 100 Brookline Ave., Boston 15, Mass. This new high-capacity pump operates against a modest forepressure of approximately 500 microns of mercury. The pump is built entirely of metal and has four stages of jets, giving it its high pumping speed. The inlet flange is 8 in. in diameter for large gas handling capacity. The pump is equipped with an electrically heated boiler having an automatic thermostat equipped with a built-in cutoff switch to disconnect the power in case the cooling water supply should fail or the boiler should overheat. Water-cooling coils on the boiler give a short cooling-down time and allow for rapid exposure of the pump to atmospheric pressure after use.

Pumps of this type are stated to have moved high vacuum out of the laboratory into industry where they are now being employed in the dehydration of penicillin, blood plasma and food, and in the production of magnesium by the ferro-silicon process.

ROTARY PUMPS

FOR THE HANDLING of liquids possessing inherent lubricating qualities, Goulds Pumps, Inc., Seneca Falls, N. Y., has announced a new line of rotary pumps of the double-helical or herringbone-gear type, which are available in ten sizes ranging from $\frac{1}{4}$ in. suction and discharge (1- $\frac{1}{2}$ g.p.m.) to a 24 in. design with capacity ranging from 50 to 75 g.p.m. The maximum working pressure in all sizes is 75 lb. All pumps are available for either direct drive through a flexible coupling, or for belt drive. The pumps are of simple construction, involving only two moving

parts, a split bolted type gland, renewable bearings, and a built-in relief valve. All are said to be exceptionally quiet in operation. Bearings are of high-lead bronze fitted with grease lubricators. The extra deep stuffing box is fitted with metallic packing, the bronze gland being split in half for easy removal. The relief valve is of the stainless-steel-ball type, built into the pump cover and externally adjustable. In addition to the standard fitted type, all pumps are available with all parts of iron or steel, or in all-bronze construction.

EQUIPMENT BRIEFS

FIFTY different formulas covering the range from 2.0 to 12.0 pH in steps of 0.20 pH are available in the new line of Coleman certified buffer tablets which are now being offered by Burrell Technical Supply Co., 1936 Fifth Ave., Pittsburgh 19, Pa. Dissolving one of the tablets in 100 ml. of warm distilled water gives a buffer solution claimed to be exact in pH. The tablets are provided in sealed containers holding 12 tablets.

For the non-destructive examination of a variety of materials, such as plastics, leather, glass, ceramics, light alloy metals and thin sections of heavier metals, the Picker X-ray Corp., 300 Fourth Ave., New York, N. Y., is offering a new 50-kv. industrial X-ray unit which operates at low voltage, giving a long wave length of X-radiation. The new unit is shock-proof, ray-proof, and rated for continuous operation over long periods. It is self-contained and consists of the X-ray tube, the high-voltage transformer, the control unit and the enclosing cabinet and retractable hood. The control unit gives 20 steps of control from 5 to 50 kv. output. The exposure circuit is provided with a heavy-duty contactor controlled either by a separate exposure switch or by a timer, which is also controlled by a separate small toggle switch. The timer automatically limits preset exposure periods up to 30 min. in one-half-minute graduations.

RESISTANCE of the Lucite methyl methacrylate resin manufactured by E. I. du Pont de Nemours & Co., Wilmington, Del., to attack by acids is the basis for a new use of this plastic in the lining of tanks holding chromic and sulphuric acid anodizing solutions in the treatment of aluminum alloy. Such Lucite sheets have been used in lining 28,000-gal. tanks. Lucite is said not to be affected by sudden temperature changes nor by the 15 percent chromic acid solution used, and it is claimed to have extended the life of the tanks indefinitely.

TRUSCON LABORATORIES, Caniff & Grand Trunk R. R., Detroit 11, Mich., has announced a new floor coating product, known as Saf-T-Dek, which was developed originally to insure safe footing aboard ship. The product is now available for civilian industrial use for slip-proofing floors. This material, it is claimed, represents the first attempt to use a heavy enough non-slip plastic covering, resulting in a coating which is said to be extremely tough and

tenacious, and which sticks to any surface, including wood, steel and concrete, and even glass. The material is available in two standard colors, tile red and concrete gray, and is troweled on $\frac{3}{8}$ -in. thick. High resistance to surface wear, and long life, are claimed.

THREE-POINT GAGE CO., 3821 Broadway, Chicago 13, Ill., whose pipe-measuring gage was initially described in our issue of November, 1943, has developed an improvement enabling the gage not only to measure instantly the sizes of all pipe from $\frac{1}{4}$ to 12 in., but also all sizes of electrical conduit and thin-walled metallic tubing. The gage is of pocket size and consists of two pivoted steel plates with edges curved at three points for contact with the pipe or tubing to be measured, together with scales automatically showing the standard sizes of the three kinds of pipe and tubing mentioned.

AN IMPORTANT new use for its needle-type surface pyrometers, mentioned by Cambridge Instrument Co., Grand Central Terminal Building, New York 17, N. Y., is in measuring the internal temperature of plastic preforms heated by high frequency current. Using a needle pyrometer in this fashion, it is claimed to be easy to adjust the time cycle of the preheater for close temperature control, and to determine the uniformity of heat distribution.

MULTI-WALL BAG FILLER

TYPE 100 LS is the designation of a new screw-type filling machine for loading granular materials into bags of the multi-wall valve type. Manufactured by the St. Regis Paper Co., Engineering and Machine Division, of Oswego, N. Y., the machine has a capacity range between 25 and 100 lb., filling from 60 to 90 bags per hour with a predetermined weight of dry, granular or powdered material. The material is delivered from overhead to a hopper equipped with a power driven agitator to prevent bridging or clogging. Material flows into a feed screw which injects it into the bag through a tube from which the bag is suspended. Read-

Granular material filler for valve bags



ing the scale, the operator is able to reduce the feed rate when the desired weight is approached, allowing the final material to dribble into the bag for accurate filling. Then the bag is shaken automatically and lifted so that the clamp is released and the bag can be removed. Tucking in the valve lips completes the operation.

PREFORM PREHEATER

DESIGNATED as Model 2-P Thermex is a new automatic high-frequency preheater for plastic preforms recently announced by the Thermex Division of the Girdler Corp., Louisville, Ky. This device, which operates at a frequency of 25 to 30 megacycles, using 230-volt, 60-cycle, single phase current, has an output in excess of 3,400 B.t.u. per hour. The unit measures 28 x 28 in. and stands 47 in. high, weighing only 614 lb. Being completely automatic, it requires only plugging into the supply line and loading and unloading of the preform drawer. Closing the drawer all the way turns on the high-frequency power and timer. At the end of the prescribed time, which may be anywhere from 5 or 10 seconds up to 2 minutes, the red indicating light goes out, the operator removes the tray and unloads the preforms into the mold cavities.

Combination Avoirdupois-Metric Scale

The accompanying view shows a new dial for portable scales manufactured by the Toledo Scale Co., Telegraph Road, Cleveland, Ohio, which gives both avoirdupois and metric readings directly, without mental calculation. It will be noted that the dial contains two scales, the inner being the metric, the outer the avoirdupois scale. This feature adapts the scale to both packaging and compounding operations.



Loading preforms into high-frequency heater



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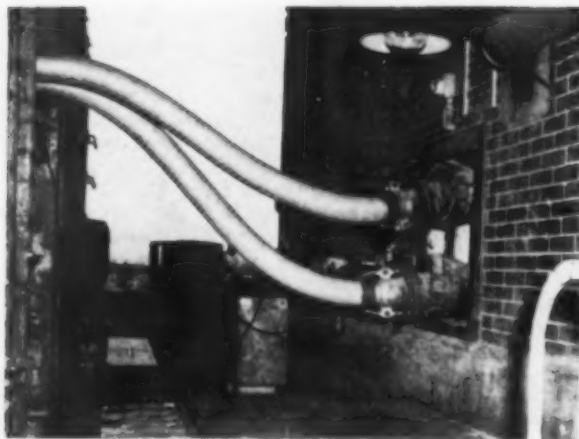
Consult Girdler on your problems concerning hydrogen sulphide, carbon monoxide, carbon dioxide, natural gas, refinery gases, liquid hydrocarbons, hydrogen, nitrogen.

Originators of the
Girbotol Process

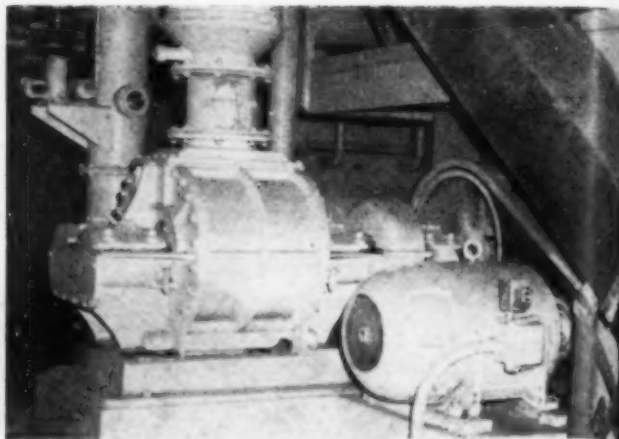
The GIRDLER CORPORATION

Gas Processes Division - Louisville 1, Ky

CHEMICAL
ENGINEERS
AND
CONSTRUCTORS



1 Grain entering the plant is weighed on track scales and is unloaded by a pneumatic conveyor system



2 A cycloidal-type blower is used in the system for conveying grain to cleaning equipment and storage bins

—CONTINUOUS COOKING OF CEREAL GRAIN

JOSEPH E. SEAGRAM AND SONS, INC. has developed a continuous process for cooking and converting cereal grains into a fermentable mash. The advantages of this development are: (a) A minimum of construction materials and building space is required; (b) equipment is simple and consists mainly of catalog items; (c) thermal efficiency is high and at the Louisville plant, for instance, 100 percent of the cooking steam is regenerated and reused; (d) operation is entirely automatic; (e) storage of milled grain is eliminated; (f) high yields of alcohol are obtained.

Grain is unloaded from cars by a pneumatic conveyor system. It is cleaned and transferred to storage bins, and the grain to be cooked is weighed by automatic scales. This grain passes over an automatic feeder to a magnetic separator, and then goes directly into roller mills where it is ground to the desired fineness. Dropping into a small slurry vessel, the meal is mixed with water and stillage at 122 to 160 deg. F. This mash is pumped by a triplex pump to a jet heater, where it is instantaneously heated by steam

to the cooking temperature, 350 to 360 deg. F. The heated mash passes through a series of U-bend pipes, where it is held for 60 to 70 seconds to complete the cooking, after which it is instantaneously cooled to 145 deg. F. in a vacuum flash chamber. The flash steam is reused for distillation purposes in a vacuum beer still.

Meanwhile, barley malt equivalent to approximately eight percent of the total grain is weighed, metered and milled as described above. The malt is mixed with a stream of water at 145 deg. F. in a mixing vessel, where the malt enzymes infuse into the water for a period of two minutes. This malt mash is then pumped into the main mash stream, and the mixture goes through pipelines to the coolers and fermenters. It is in this pipeline that saccharification to maltose is effected in two minutes at 145 deg. F.

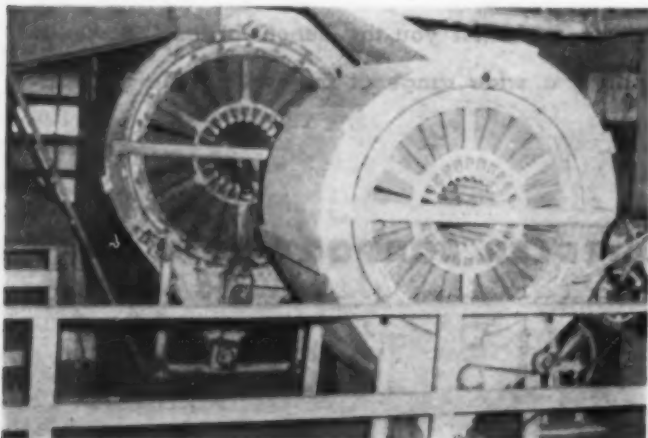
This process is a typical example of the way in which an ancient art is being converted into a modern engineering and bacteriological science.

CHEMICAL & METALLURGICAL ENGINEERING

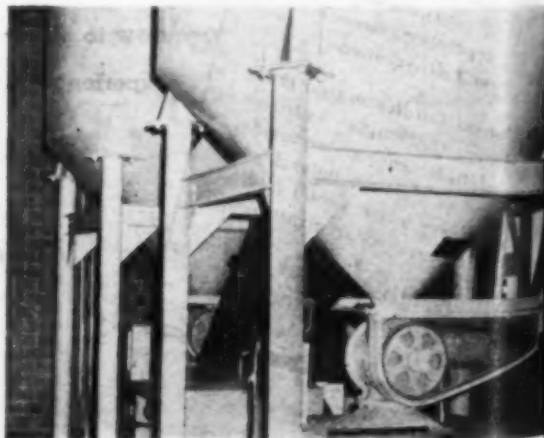
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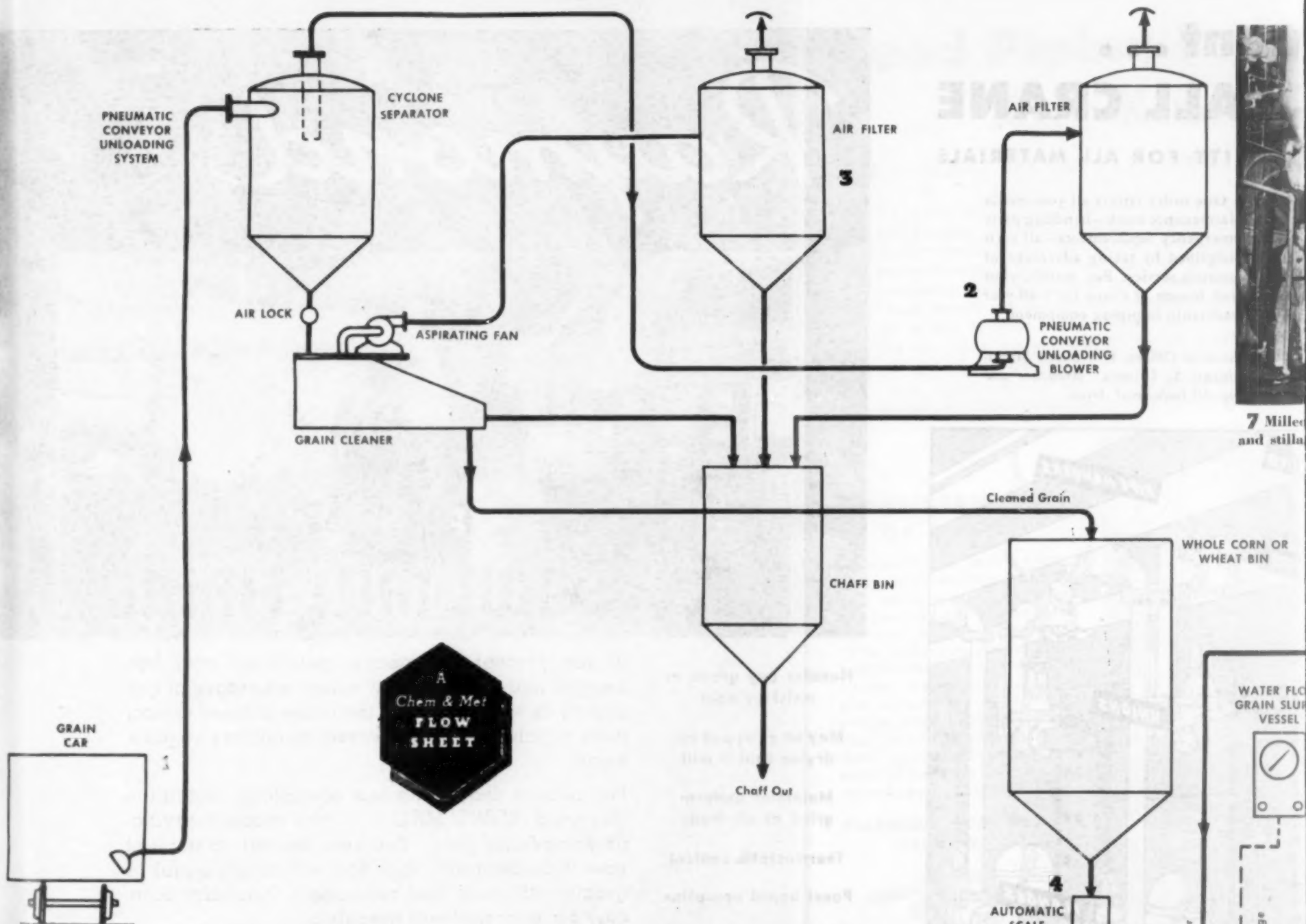
PAGES 142 to 145

3 Air stream from the pneumatic conveyor system is filtered in order to remove all grain dust and chaff

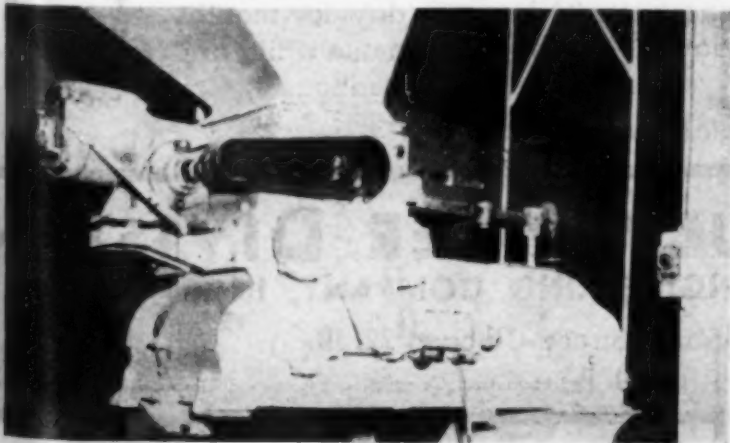


4 Cleaned whole grain is fed from the storage bins through an air-lock to special automatic scales

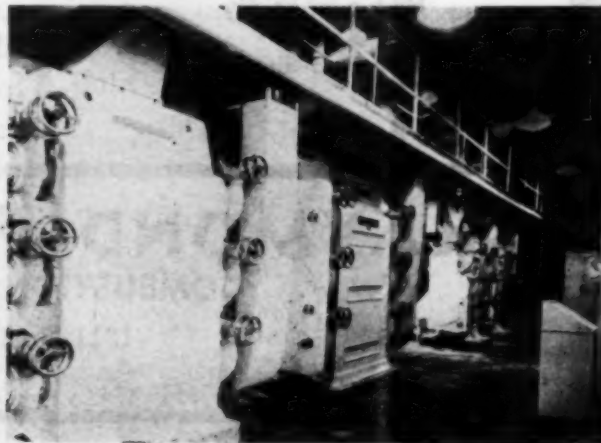


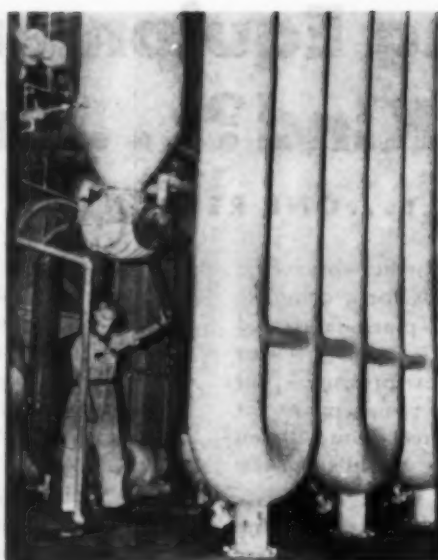
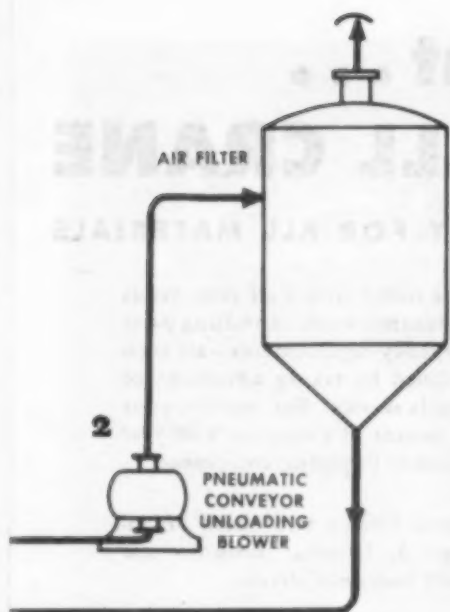


5 After being automatically weighed, grain runs to roller mills. Automatic feeders control the speed and amount of flow

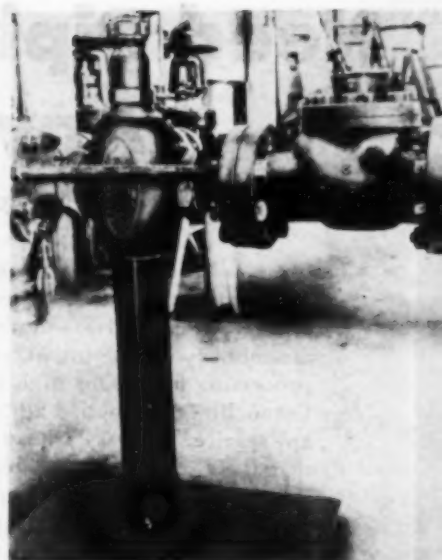


6 Milled through three-high roller mills, the stream of grain is ground to the desired fineness

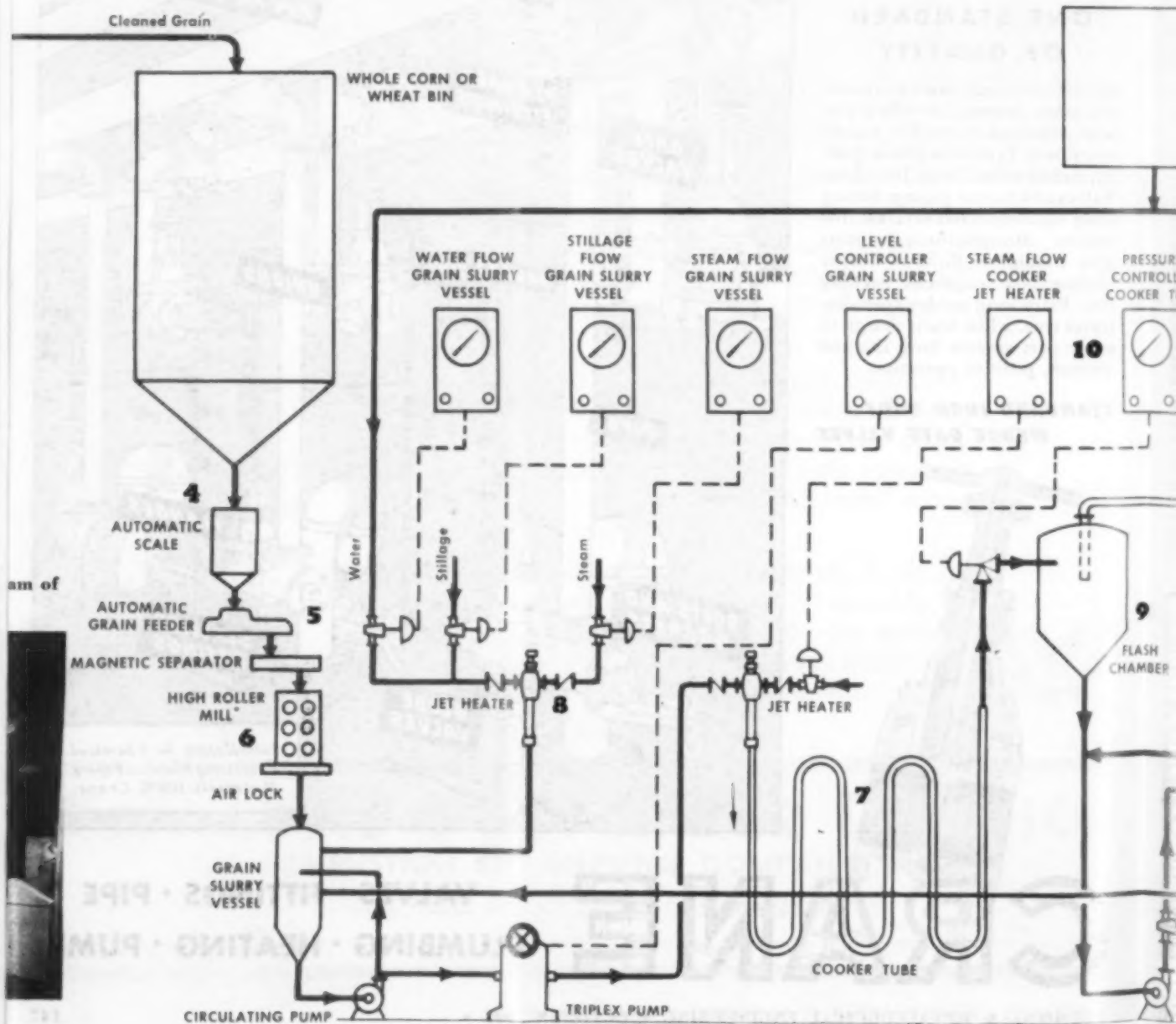


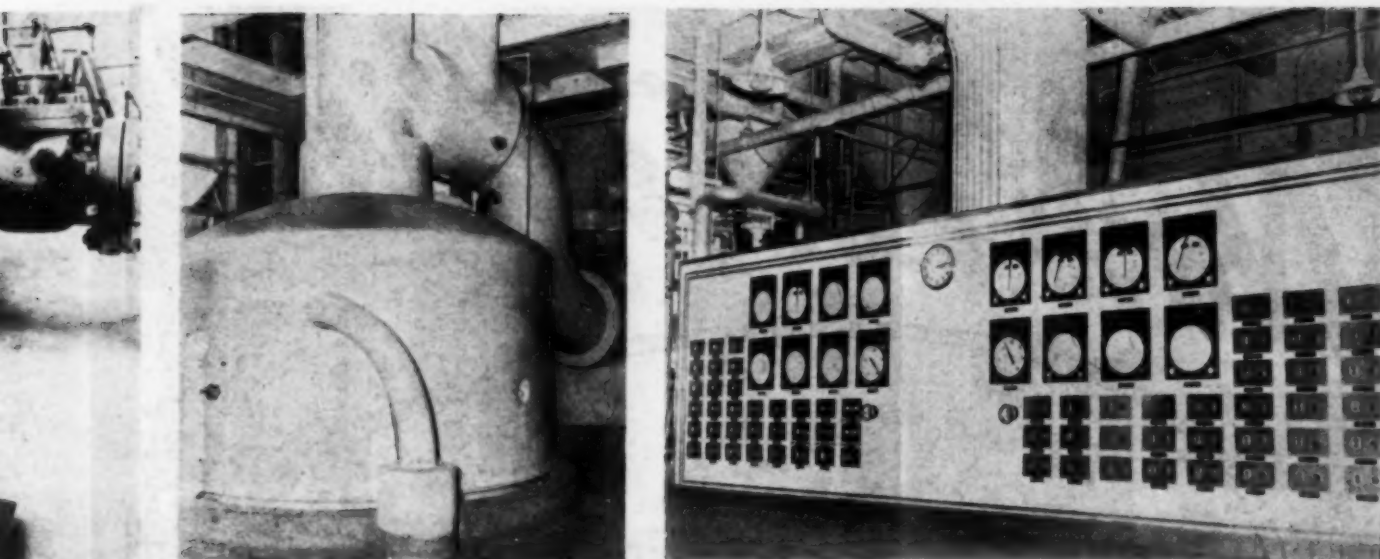


7 Milled grain is mixed with warm water and stillage and cooked in a U-tube



8 Mash is heated instantaneously by steam to the cooking temperature in a jet heater

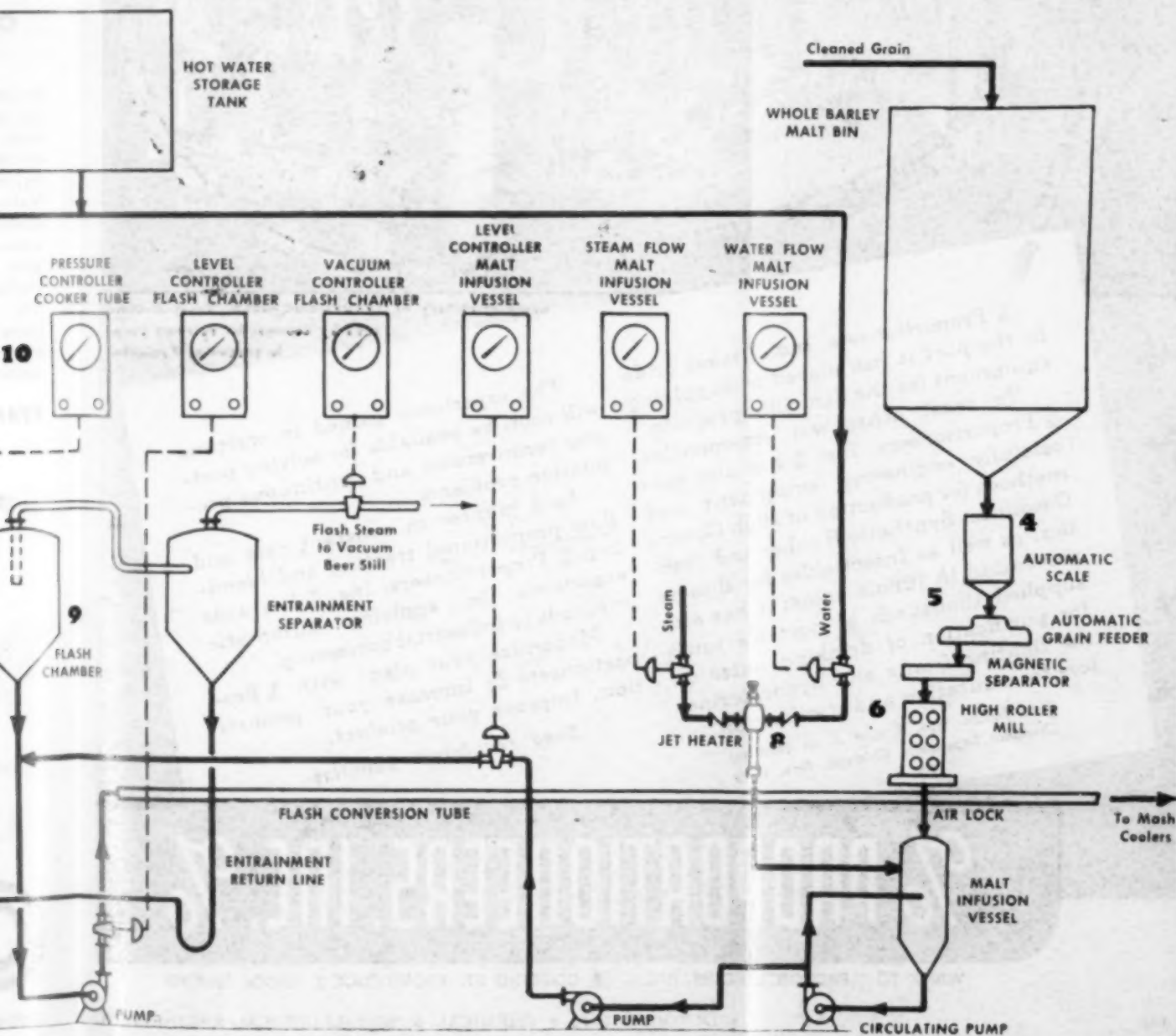




ously by steam
in a jet heater

9 Superheated mash is cooled to malting temperature in vacuum flash chamber

10 All operations of grain handling, weighing, cooking and malting are controlled from a centrally located panel board



Now Penicillin!

% Proportioneers, Inc. % takes pride in the part it has played in supplying equipment for the Penicillin program. To meet other war emergencies, % Proportioneers, Inc. % has also successfully engineered equipment and methods for production of High Octane Gasolines, Synthetic Rubber and Plastics, as well as Insecticides for disease prevention in jungle areas; it has also supplied thousands of portable units for purification of drinking water on the fighting fronts and hypochlorinators for sanitation and sterilization.

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ing installations. One order covers all your needs at any one time. Maintenance work—handling parts stocks—getting emergency replacements—all such procedures are simplified by taking advantage of Crane *complete materials service*. But, mainly, your installations get full benefit of Crane Co.'s 89-year experience and leadership in piping equipment.

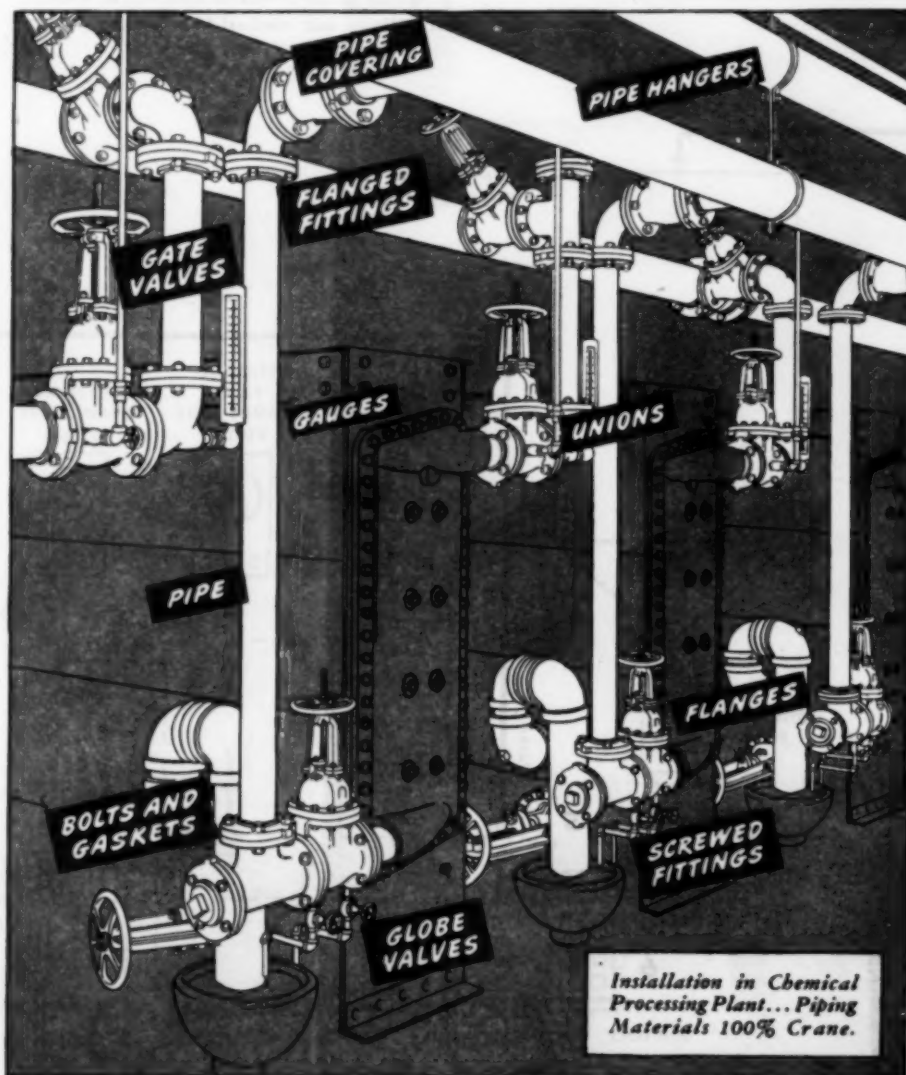
CRANE CO., General Offices: 836 South Michigan Avenue, Chicago 5, Illinois. *Branches and Wholesalers Serving All Industrial Areas.*



ONE STANDARD OF QUALITY

From end to end, piping systems are more dependable when one high standard of quality guards every part. Typical of Crane quality, here's what Crane Iron Gate Valves add to your piping: Strong body sections resist severest line strains. Straight-through ports give streamline flow. A deeper stuffing box lengthens packing life. Extra long guides keep disc travel true, while finest design in every part assures long life and smooth, positive operation.

STANDARD IRON BODY WEDGE GATE VALVES



CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Raymond



BOWL MILL FIRING

Handles any grade or moisture coal

May be equipped for drying coal in mill

Maintains uniform grind at all feeds

Thermostatic control

Panel board operation

Noiseless, dustless and vibrationless

High availability

Tramp iron disposal

IN the present emergency, powdered coal has stepped into the breach to relieve shortages of gas and oil as well as to take the place of these critical fuels, which must be conserved for military requirements.

For utilizing coal to the best advantage, install the Raymond BOWL MILL . . . the modern drying-grinding-firing unit. You can convert your plant now with assurance that you will obtain equal or greater efficiency and permanent, long-term economy for your post-war operation.

It is the logical direct-firing unit for all types of rotary kilns and industrial furnaces . . . capable of continuous operation 24 hours a day for months without shutdowns . . . easy adjustments while running . . . and requiring minimum attention.

For details, see Catalog #43



RAYMOND PULVERIZER DIVISION

COMBUSTION ENGINEERING COMPANY, INC.

1311 North Branch Street, Chicago 22, Ill.

Sales Offices in all Principal Cities

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NEW PRODUCTS AND MATERIALS

JAMES A. LEE, Managing Editor

TRICHLORCUMENE

SEMI-COMMERCIAL production of trichlorcumene, (isopropyl trichlorbenzene) has been started by Hooker Electrochemical Co., Niagara Falls, N. Y. Described as a colorless liquid with a mild, aromatic odor, the chemical is a mixture of isomers. Insoluble in water, it is soluble in alcohol and organic solvents. The material is said to be highly stable and may be useful as an antifreeze for special purposes, as a component of insecticides, protective coatings, paint removers and plastic compositions, and as a solvent for many materials.

Trichlorcumene has been found to be compatible with the following types of plastics. The nature of the resultant material is indicated as soft (S), rubbery (R), tough (T), and brittle (B).

Modified phenolic resin (S)
Benzyl cellulose (T) (B)
Chlorinated piccolyte (S)
Phenol formaldehyde (S)
Ester gum (S)
Rosin (S)
Natural asphalt (S)
Methacrylate interpolymers (T) (R)
Poly terpene resin (S)
Piccoumaron (S)
Poly vinyl chloride (R)
Polystyrene (R)
Chlorinated rubber (R)

Physical Properties

Molecular weight (pure trichlorcumene) 223.5
Freezing range, deg. C. -30 to -45
Boiling range, deg. C. 245 to 265
Refractive index, n_D^{20} 1.535 to 1.560
Specific gravity, 15.5/15.5 deg. C. 1.26 to 1.32

NATURAL ANTI-OXIDANT

PRESERVATION of the sweet flavor of foods containing either animal or vegetable fats is one of the uses of nor-dihydroguaiaretic acid, originally developed at the University of Minnesota, and manufactured by the Wm. J. Stange Co., Chicago, Ill. Derived from the creosote bush, which is a type of low, scrubby vegetation growing wild in semi-arid regions of the Southwest, N.D.G.A. looks like granulated sugar after it has been extracted from the weed and refined. This anti-oxidant is finding many uses in the fields of food production and pharmaceuticals. For the duration of the war, however, according to the manufacturer, all of the chemical produced will be reserved for use in foods for the armed services, where, heretofore, it has been difficult to transport food containing fats and oils without impairing the original tastes.

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CELLULAR RUBBER MATERIAL

STRENGTH, hardness, and light weight characterize Cell-Tite, an ebony-like cellular rubber material from which propeller fairings are made, according to the manufacturers, the Sponge Rubber Products Co., Derby, Conn. The makers also claim that the material has the best strength-weight ratio of any material produced commercially. The product has more buoyancy and lower water absorption than cork; it has good thermal, electrical, and sound insulation qualities, and can be molded to almost any shape and form. It can be sawed, drilled, planed, and otherwise worked much the same as wood.

ALKALINE STRIPPER

FOR THE rapid removal of zinc plate, the Enthone Co., New Haven, Conn., announces the development of an alkaline stripper called Enthone Zinc Stripper. This product is said to strip zinc plated coatings of all types. Thicknesses of the order of 0.001 in. will strip in 30 sec., leaving the metal clean and bright. Due to the alkaline nature of the solution, the tendency for rusting of the steel after stripping is largely removed, whereas this

is a serious problem when acid strips are used. According to the manufacturers, there is no attack upon the base steel from the stripper and the base metal, therefore, is left in its original clean condition after stripping. The stripper is also effective for removing zinc coatings that have been treated with various chromate processes, and for all types of bright zinc plates. The stripper is supplied as salts which are added to water in the concentration range of 2 to 3 lb. per gal., and the mixture heated from 200 to 215 deg. F. Plain steel tanks and heating coils are used.

DICHLOROSTYRENE

HEAT-RESISTANT plastic or synthetic rubber can be made from a chemical announced by the Mathieson Alkali Works, New York 17, N. Y. Known as dichlorostyrene, the material gives to its plastic product excellent heat resistance and electrical insulating properties. Other plastics, say the manufacturers, are available with either one of these properties, but the Mathieson product is unique in its combination of properties, being more resistant to heat than any plastic which combines good electrical characteristics with strength, machinability and moldability.

Previously announced by Mathieson was a new rubber. Heretofore, because of government regulations, the manufacturers were unable to announce the nature of the new chemical which made the rubber possible. Now, however, they announce that dichlorostyrene is a chlorinated product whose monomers are highly active and polymerize readily. Polydichlorostyrene, the plastic which is formed by this polymerization, resembles polystyrene in chemical resistance, solubility and general appearance. It differs from polystyrene principally in resistance to heat, having a heat distortion point of 240 to 265 deg. F., as compared with 165 to 190 deg. F. for polystyrene. The new plastic is more resistant to water, say the manufacturers, and is stable, showing no tendency to lose hydrochloric acid. It may be molded by conventional methods, although some modifications in injection molding and extruding technique are necessary due to the high distortion temperature and melting point.

The plastic is readily copolymerized with other unsaturated compounds to form rubber-like products. Again, the outstanding characteristic of the rubber formed by the copolymerization of dichlorostyrene with butadiene is heat resistance. It is reported that the Mathieson rubber gives its best performance when containing 30-40 percent dichlorostyrene, or 12-14 percent chlorine.

FILLING COMPOUND

FOR FILLING small transformers and for general filling work, a filling compound has been developed by Sterling Varnish Co., Haysville, Pa. The material is said to be very firm, having considerable resiliency. Two separate parts, one a viscous liquid and the other of low viscosity, supply the compound and must be mixed immediately before using as they react slowly at room temperature. For a period of 4 to 5 hr., however, the mixture retains sufficient liquidity for pouring. At 60 to 70 deg. C., the compound, known as S-182, starts to set in about an hour and becomes well-dried overnight. According to the manufacturers, the new compound has a high dielectric strength, a low coefficient of expansion, and is water resistant and oil-proof. It will withstand temperatures up to 200 deg. C. without resoftening and does not become brittle at temperatures as low as -60 deg. C.

FUNGUS-RESISTANT COATING

TROPICALIZATION of communications equipment with fungus-resistant coating is now possible with a finish made by Maas & Waldstein Co., Newark 4, N. J. Designed for application on phenolic insulators, terminal blocks, junction blocks, and the fixed windings of motors, generators, and dynamotors, the coating is a varnish, and may be applied by spray, dip, or brush. According to the manufacturers, the material has been successfully tested for dielectric strength, hardness, flexibility, and resistance to salt spray and thermal shock. The product is marketed as Durad Fungus Resistant Coating No. 524.

PLASTIC FLOOR MATTING

By FIRMLY binding friction compound together by a plastic, a solid plastic friction type mat, marketed under the name of Ameritred, is made. Useful in many of the places where rubber matting was formerly used, this flat, non-skid matting is now available at the American Mat Corp., Toledo 2, Ohio. Said to be easily cleaned, the material does not swell as rapidly as rubber where exposed to various types of oils.

PLASTIC CEMENT

COMPOUNDED of selected resin bases with complex non-resin materials to yield a tough, pliable, continuous film capable of joining many combinations of materials, Plastic, a synthetic resin adhesive, is a soft, white fluid. Produced by Paisley Products, Chicago 16, Ill., the cement may be used in its natural state or reduced with water. Application may be by brush, spreader, dipping, flow, or spray gun. When dry, the film formed is semi-transparent, glossy, and flexible. It has, according to the manufacturer, excellent heat-selling properties. In the liquid state, when used for bonding materials, the cement can be applied to one or both surfaces; the porosity of the materials used determining the setting speed. It is said that Plastic is being used in many industrial opera-

tions as a replacement for rubber latex. Paper, cotton, cork, leather, plastics, and stone are among the materials suggested for application.

WOOD PRESERVER

DAMAGE caused by dry-rot, fungi, and molds in almost all types of wood can be controlled or prevented, according to the manufacturers of Triple-A Copper Naphthenate Wood Preserver, the Quigley Co., New York 17, N. Y. Green in color, the preserver is said to penetrate deeply and to impregnate wood, sealing it against the destruction by organisms. It may be applied by brush, spray, or dipping. It is non-poisonous to humans and will not bleed through when light colored paints are applied over the wood preserver.

FLOOR CLEANER

AFTER treatment with Synkrete, a highly concentrated treatment for cement floors, the floors are said to be far harder, more resistant to water infiltration, oils, greases, and chemicals, according to Synthex Products Co., New York 19, N. Y., makers of the compound. The material is diluted with three parts water before use and provides coverage for at least 1,000 sq. ft. per gal. After application by mop, brush, broom, or sprinkler, the cleaner soaks deep into the pores of dusting concrete, where it hardens to form a rocklike mass that is insoluble in water, reinforces the binder and prevents surface particles from being worn away. The makers say that although a single coat of Synkrete will allay dusting, two or more are usually recommended for best results. The liquid is almost colorless and does not affect the floor appearance. When floors are to be painted later, a treatment with the material acts as a sizing, encouraging the paint to last longer, with less tendency to peel or blister.

HEAT RESISTING PAINT

TO SECURE maximum protection and decoration on surfaces subjected to high heat, the Quigley Co., New York 17, N. Y. has developed a paint known as Triple-A High Heat Resisting Paint, which is said to withstand temperatures as high as 2,500 deg. F., or over.

The resistance to heat depends on the surface to which the paint is applied. On light steel it will adhere under rapid heating and cooling up to 1,400 deg. F. On alloy, brick, etc., it will stand 2,500 deg. F. or over. The manufacturers claim that it is non-flammable, non-irritating, and that it does not give off fumes or odors when being applied, upon drying, or when subjected to heat or flame. The paint must be heat-treated on extremely wet interior surfaces, and for exterior use on metals. When heat-treated, it will resist water, oil, gasoline, benzol, heat, and weather.

IRON SPONGE

WOOD SHAVINGS and chips which have undergone a chemical treatment with oxidizing reagents form a material known as Connelly Iron Sponge Grade

B, produced by the Connelly Iron Sponge and Governor Co., Chicago, Ill. This material is a special highly active iron sponge which is reported by the company to have exceptional ability to remove hydrogen sulphide from a gas.

THERMOPLASTIC

A VERSATILE thermoplastic resin, suitable to injection and extrusion molding is the description of Chemco polystyrene offered by the Chemco Corp., Berkeley Heights, N. J. According to the manufacturers, the product can also be compression molded but the result is not as tough and flexible as is the former.

The resin may be molded on any type of thermoplastic injection molding machine having conventional heat and pressure controls. The molding cycle is comparable to that of cellulose acetate, but the yield of finished pieces is higher because of the low specific gravity. Because Chemco polystyrene is a thermoplastic material, sprues, gates and rejected pieces can be ground and remolded.

SYNTHETIC RUBBER ADHESIVES

HEAT-VULCANIZATION, air curing, metal adhesion, and general "utility" work are some of the uses of the new line of synthetic rubber cements developed by the B. F. Goodrich Co., Akron, Ohio. The cements fall into three categories: the first, for heat vulcanization, air-curing, and cold adhesions, contains cements that when compounded, are suitable for fabric, leather, and synthetic adhesions to themselves or to each other; the second, for metal adhesion, contains two special cements, known as the Plastilock 30 series, the first of which is used with vulcanized neoprene when it is bonded to porcelain, metal, etc., while the second is used with uncured neoprene for the same purpose; the third, for general utility use, is a type of adhesive which will stick to almost any clean surface. The company says that the latter adhesive serves its purpose as well as natural rubber cements in the same field.

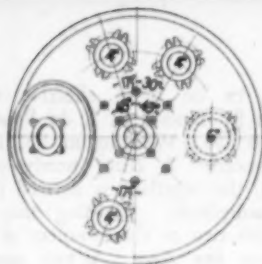
SYNTHETIC RUBBER

EXTREME low-temperature flexibility without the addition of plasticizers, plus resistance to solvents, ozone, and sunlight, mark Thiokol "ST," a type of synthetic rubber developed by the Thiokol Corp., Midland, Mich., as the answer to many production problems heretofore unsolved by either natural rubber or synthetics, according to the manufacturers.

It is claimed that this synthetic rubber has marked resistance to the "cold flow" prevalent among the polysulphide synthetics and also that the odor commonly associated with polysulphides has been reduced. The rubber has low volume swell in hydrocarbon fuels, which makes it useful in the aviation and automotive industries for sealants, cements, and acid-resistant coatings.

INSECT REPELLANT

SUCCESSOR to citronella is dimethyl phthalate, an insect repellant, found by



"E" Series—
for internal
pressures up
to 38 p.s.i.
5-gallon to
2,000-gallon
capacity and
up. Remov-
able clamp-
on heads.

Standardized Pfaudler Reaction Kettles Give You 3 Major Advantages

There are three major advantages to you in the two standardized series of Glass-Lined Steel Reaction Kettles, Pfaudler originated and developed.

1. You can meet the majority of your processing problems, including a surprising number of special setups, with these standardized units.
2. Should you desire to change your process or to use your equipment for an entirely different product, you can do so. Even though your present products may not involve acids, you are prepared for such a future contingency.
3. This standardization in the complete line of Pfaudler Kettles from 5 gallons to 2000 gallons capacity, permits you to work from laboratory through pilot or semi-works plant to full scale production under identical conditions.

The "E" Series of low-pressure kettles (for internal pressures up to and including 38 p.s.i.) is made up of 7 groups, all units of each series with the same diameter and top-head. Capacity variations in each series are accomplished by change in depth of bottom section. The top-head is provided with all essential openings, size and position based on experience. Heads are removable, so that anchor type agitators or three blade impellers may be used. Agitator shaft which is hollow can be used as a thermometer well. Baffles can be incorporated where desired. Addition of vertical flange vapor outlet in top-head converts reaction kettle into distillation unit.

The "R" Series for higher working pressures, (internal pressures up to and including 125 p.s.i.) are built with welded heads in 350, 500, 750, 1000, 1250, 1500 and 2000 gallons capacity. They also provide the same standardization advantages of the low pressure series. Glass-lined double jacketed condensers, or "hairpin" condensers, glass-lined pipe, glass-lined vacuum receivers combined with glass-lined pipe, fillings and valves permit processing in the total absence of metals.

The upper limits of pressure, size and temperature are constantly being raised due to continuous ceramic research. If you have ruled out glass because of any of these factors, we suggest that you get in touch with us for the latest developments.

VISIT BOOTH 70...

NATIONAL CHEMICALS EXPOSITION CHICAGO NOVEMBER 15-19
Bulletins 817 and 810 describe this line of Pfaudler Glass-Lined Equipment, give complete specifications and include dimensional drawings. The Pfaudler Co., Rochester 4, N. Y.



PFAUDLER

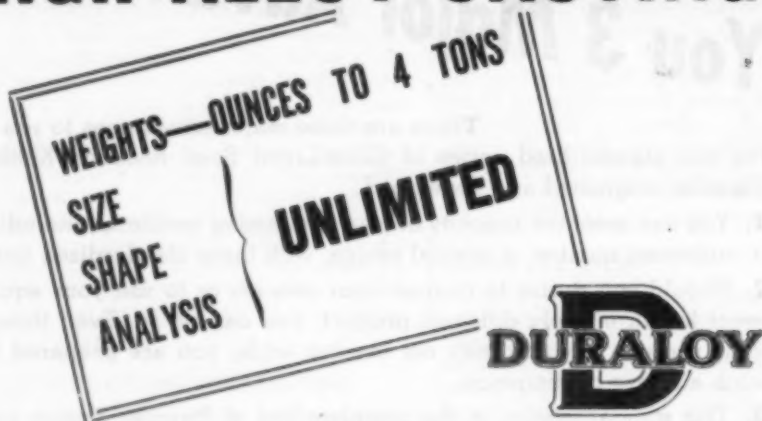
THE PFAUDLER CO., Rochester 4, N. Y. Branch Offices: 130 West 42nd St., New York 18, N. Y.
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"R" Series—
for internal
pressures up
to 125 p.s.i.
350-gallon
to 2,000-
gallon
capacity.
All-welded
one-piece
jacketed
closed
construction.



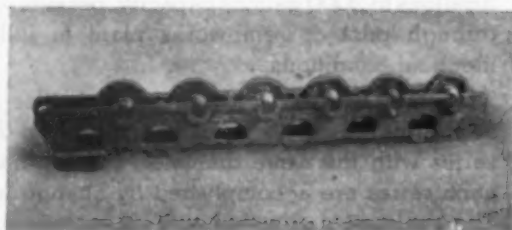
DURALOY ^{for} HIGH ALLOY CASTINGS



FOR high alloy castings—those durable chrome-iron and chrome-nickel castings—DURALOY is a leading source.

One of the first to produce castings of high alloy metals, DURALOY works with nothing else. In static and in centrifugal castings, DURALOY has the experience, men and facilities unsurpassed by any plant.

We can recommend the best alloy for your purpose and do the job from drawing board to machine shop, or we can work to your design and specifications.



19-DU-7

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the army to be more effective than "peacetime fly dopes," E. I. du Pont de Nemours & Co., Wilmington 98, Del., has announced. A clear, nearly odorless liquid, the repellent is derived from phthalic anhydride. Clothing may be sprayed with two or three ounces of the liquid every five days. When applied to the skin, the repellent provides protection for one to six hours. The manufacturers state that clothing may be sprayed while worn, although the eyes and mouth should be covered to avoid discomfort from a stinging sensation. The company also emphasized that the new material is not an insecticide, but an insectifuge or repellent.

AGRICULTURAL FRIT

SUPPLYING the most generally encountered deficiencies of the minor essential elements to plants and soil organisms, "Tracel" agricultural frit is a combination of manganese, copper, zinc, and boron in a slowly available form for plant and soil nutrition. The material is sufficiently soluble to serve the timely needs of plants, yet not so concentrated and soluble as to disturb balance or to cause plant injury. Slate grey in color, the combination possesses nutrient values. It has been developed by the Harshaw Chemical Co., Cleveland, Ohio. The frit is diluted with water, and sprayed on plants as soon as foliage deterioration is noticed. Response is within 10 days. The company says that the frit fortifies the plant foliage nutritionally and is therefore a means of rendering the plants disease-resistant.

RUST INHIBITOR

A RUST preventive coating for protection of metal parts and equipment during storage, shipment, and, in some cases, in service has been developed by Witco Chemical Co., New York 17, N. Y. Known as Witco No. 673 Rust Inhibitor, this product offers a combination of advantages not heretofore available, say the manufacturers. It is a cold-dip, rapid-drying coating that may be applied either by dipping or spraying, as its viscosity is comparable to that of water. The product is also non-abrasive, non-corrosive, and easily removed with ordinary solvents. An outstanding feature of the inhibitor is its high melting point—in excess of 2,500 deg. F. The coating remains flexible both at that temperature and at temperature as low as -20 deg. F.

WATER SOLUBLE DYE

AN EFFECTIVE method of dyeing plastics with true colors of any shade without the common difficulties of expense, disagreeable odors, and fire hazard, has been developed by the Great American Color Co., Los Angeles, Calif. The dye may be used on any plastic product such as methyl methacrylate, cellulose nitrate, and others, or on molding resins such as cellulose acetate or acetobutyrate. According to the manufacturers, exposure to sunlight for as long as two weeks fails to bring out any discoloration in the dyed plastics.

The clear colors may be obtained by heating plain water to the boiling point

MONSANTO GVL

A Completely Water-Miscible
Solvent with a Wide Range
of Possibilities

SEND FOR SAMPLE

Gamma Valerolactone is an unusual solvent that has a wide range of possibilities in the manufacture of war-essential products. Samples for experimental purposes will be sent free and without obligation in response to requests on company letterheads.

Monsanto GVL, which is non-irritating and safe for all normal uses, is completely miscible with water. It also is miscible with most organic solvents and plasticizers and with resins, waxes, oils, fats and acids, except anhydrous glycerine, polyvinyl alcohol, glue, casein, gum arabic and soya bean protein. It is slightly miscible with zein, degrass, beeswax, petrolatum and mineral spirits.

If physical properties of Monsanto GVL suggest possible applications in your war production, we shall be pleased to supply you with a sample. Please address your inquiry to the nearest Monsanto Office or to MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri. District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Los Angeles, San Francisco, Seattle, Montreal, Toronto.

MONSANTO
CHEMICALS

SERVING INDUSTRY...WHICH SERVES MANKIND

PHYSICAL PROPERTIES

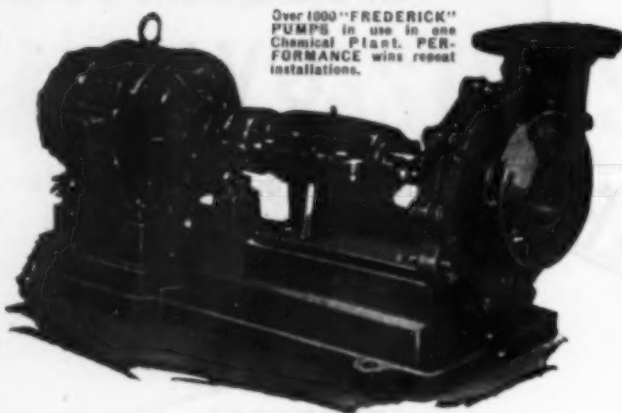
Appearance	Colorless, mobile liquid
Formula	$C_6H_8O_2$
Molecular Weight	100.06
Boiling Point (760 mm.)	205-206.5° C.
Flash Point (Cleve. Open Cup)	205° F.
Fire Point (Cleve. Open Cup)	220° F.
Crystallizing Point	-37° C.
Specific Gravity @ 25/25° C.	1.0518
Refractive Index @ 25° C.	1.4301
Surface Tension @ 25° C.	39. dynes/cm.
Viscosity @ 25° C.	2.18 Centipoises
pH (Anhydrous)	7.0
pH of 10% Solution in Distilled H_2O	4.2

POSSIBLE FIELDS OF APPLICATION

1. As a coupling agent in dye baths.
2. In brake fluids.
3. In cutting oils.
4. As a solvent for insecticides and fungicides.
5. As a lacquer solvent to reduce blush.
6. As a solvent for adhesives.

"FREDERICK" PUMPS MAKE GOOD

You are assured of satisfactory service when you install a "FREDERICK" Pump, GUARANTEED because they are to meet the conditions for which they are sold, and the GUARANTEE is founded on known performance.



Over 1000 "FREDERICK" PUMPS in use in one Chemical Plant. PERFORMANCE wins repeat installations.

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Sifters, Crushers, Cutters, Dry and Liquid Mixers, Mills, Grinders, Pulverizers, Conveyor Systems, Complete Installations.



The handling equipment construction "know-how" of the Mercer Engineering Works, Inc., Clifton, N. J. ... The more than 40 years processing equipment experience of Robinson Mfg. Co., Muncy, Pa. ... All are embodied in and represented by

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30 CHURCH ST., NEW YORK 7, N. Y.



Materials HANDLING EQUIPMENT



Trailer Trucks (All Types) Wheel Tractor Cranes (3 to 7 ton) Fork Lift Trucks, Lift Platforms, Hoists, Live Skids, Wheels, Casters.



and adding the dye. About 10 parts of water to one of dye is the proper ratio. When the solution is hot, the plastics can be dipped in the vat, and will take on the desired shade in a few minutes.

COATING RESIN

DEVELOPMENT of a low-cost, drying oil type resin, now available without restriction as to end use is announced by the Resinous Products and Chemical Co., Philadelphia, Pa. Known as Duraplex AL-210, the resin is adapted to air-drying finishes and is designed for use in protective paints for freight cars and structural steel; for aluminum paints, red lead primers, barracks paints, and for all kinds of industrial maintenance. The resin contains only 50 percent reportable oil.

Resembling bodied linseed oil in speed of drying and ultimate hardness and the phthalic alkyds in its pigment wetting and binding properties, the resin produces coatings that are flexible. It possesses good adhesion and wearing qualities, according to the manufacturer.

The resin differs from conventional phthalic anhydride resins in that its "alkyd" component is a permanently soft elastic material which does not accelerate the drying of the oil component. The resin is supplied as a dark colored, viscous liquid which pours slowly at room temperature.

Films of the resin are not heat reactive, and remain essentially unchanged after short bakes as high as 400 deg. F. The resin itself, however, will body further when heated in a kettle, and can be converted to a gel by heating at several hours at temperature in the range of 450 to 475 deg. F. The resin is a good general grinding medium for air-drying paints and enamels. It is soluble in mineral spirits and other aliphatic hydrocarbons, turpentine, xylol, toluol, esters, and ketones.

TEXTILE CHEMICALS

COMPOUNDS credited with the ability to make sheer stockings run resistant, remove the shine from serge suits, and make fabrics live longer, were identified as the Sytons by Monsanto Chemical Co., St. Louis 4, Mo. It was also announced that a process to make woollens shrink-proof, wrinkle resistant, and more durable, will be known as Reslooming. A third process is described as imparting water repellent qualities to cotton, rayon and wool. As with the other processes, this one does not alter or impair the original qualities of the basic fibers.

Syton treatment is accomplished through immersion, spraying or sponging with a fine colloidal dispersion of polymerized silica or quartz. In other words, individual fibers are coated with highly purified submicroscopic quartz dispersed in water. These submicroscopic fibrils of quartz, with a diameter of less than 1/4,000,000 in., form a hard and translucent film over the individual fibers, improving natural sheen, giving them added strength, and precluding shine, according to the manufacturer.

The compound most thoroughly recommended is a neutral solution, substantially free from salts or electrolytes. It may be diluted with water or solvents, is stable

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RING

in mild acid and alkali, and is compatible with water solutions or dispersions of other finishing agents, resins or dyestuffs. It is indicated that Syton will be applied on a standard textile padder, then dried in the usual manner. According to the manufacturers, no special precautions are necessary, and no curing or after-treatment required. It is said that one application may be expected to last the life of the fabric.

The third process, as yet unnamed, also involves external treatment of fibers. Water-repellant qualities are imparted through application of a tough plastic, which is impervious to water and highly resistant to heat and chemicals. The plastic used is a modified, thermosetting melamine. It is applied from a water solution on a standard textile padder, then cured several minutes at 265 to 270 deg. F. When cured it forms a water-proof film bound so tightly to individual fibers it will last the lifetime of most fabrics despite dry cleaning and washing. Color fastness, the makers say, is actually increased. Reslooming, on the other hand, impregnates individual fibers with a tough heat-water-chemical resistant plastic.

SYNTHETIC RUBBER TACKIFIER

DEVELOPED by the Heyden Chemical Corp., New York 1, N. Y., Pentacizer 344 is now commercially available as a tackifier and extender for synthetic rubber. A brown, resinous friable solid, it is soluble in ketones, aromatic hydrocarbons, vegetable and mineral oils, and synthetic rubbers. It is claimed that the use of up to 40 percent of Pentacizer 344 tends to soften and tackify GR-S and other synthetic rubbers, and that the tack will remain to a considerable extent after vulcanization. If less than 25 percent is used, the uncured stock possesses a good degree of tack, but the cured rubber is not sticky and will maintain good nerve.

PROTECTIVE COATING

FOR THE protection of concrete, stucco and brick against weathering, Waterfoil coating has been developed from non-critical materials by A. C. Horn Co., Long Island City, N. Y. The weather proofing functions of retarding penetration of moisture from the outside and permitting escape of excess moisture when expanded by higher temperature is performed by the inorganic gels in the product. The material is applied with a rough brush, and is said to weld itself into the spaces of the masonry surface as it hardens into a heavy, microscopically sponge-like coating.

SUBSTITUTE RUBBER LINING

FROM THE residue of oil refining, the Paramount Rubber Co., Detroit, Mich., has developed a substitute for rubber lining in acid tanks. The product is flowed into tanks at 550 deg. F. in layers from 1/4 in. to 1 in. thick, according to the type and concentration of acid to be used. The coating is claimed to stand more heat and to be resistant to a wider range of acids and alkalis than rubber.

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Few people think about fighting a fire until they actually face one. That's why it's important that every fire extinguisher operates easily—quickly—thoroughly!

Randolph "4" simplifies, speeds fire-fighting. This modern extinguisher with the "breath of ice" chokes gasoline, oil, paint, machine, electric fires—instantly. Hits the blaze before damage is done!

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Neat! Randolph carbon dioxide is dry and odorless. Actually disappears after the fire is out. Leaves no foam or liquids to clean up.

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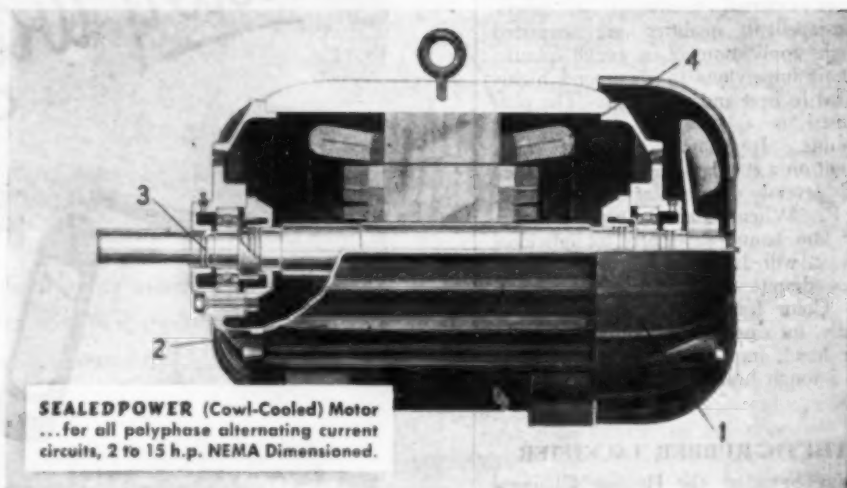
FEATURES

1. Totally Enclosed Cowl-Cooled type minimizes fire hazard, resists corrosion. Protects against acid or alkali fumes, splashing or dripping corrosive liquids, air-borne moisture, steam, corrosive gases, conducting dusts, metallic chips, lint, etc.

2. Fin Type single shell construction, with all surfaces exposed and a readily removable fan shroud, gives non-clog ventilation. Easy to clean...foreign matter passes over the surfaces of and not through the motor.

3. Patented GROOVSEAL anti-friction bearings—no greasing needed for at least a year—minimizes maintenance. Seal permits use of softer grease, for better lubrication and longer bearing life. Water-tight—Dust-tight—Air-tight.

4. Vacuum Impregnation with high grade insulating varnish seals out foreign matter and moisture from each individual coil...makes windings a homogeneous mass...reduces hot-spot temperature and lengthens insulation life. Adherence of varnish prevents vibration of wires inside or outside of slot.



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THE CHEMICAL INDUSTRY has many processes where the conventional open type motor drives are unsuitable. Crocker-Wheeler's new totally-enclosed **SEALEDPOWER** motor largely eliminates difficulties encountered in chemical plants. The design of the motor protects it against steam, moisture, acid, alkali, splash, drip, fumes, and corrosion found in all phases of chemical processing.

Therefore, this **SEALEDPOWER** Motor is a must for all plants where corrosive conditions exist.

Crocker-Wheeler, one of the leading manufacturers in the field, specializes solely in the design, manufacture and application of electric power equipment.

As power specialists, Crocker-Wheeler field engineers know the power needs for your industry—of your particular production processes.

Call in one of our experienced engineers for specific advice on motors, generators, couplings and control... no obligation.

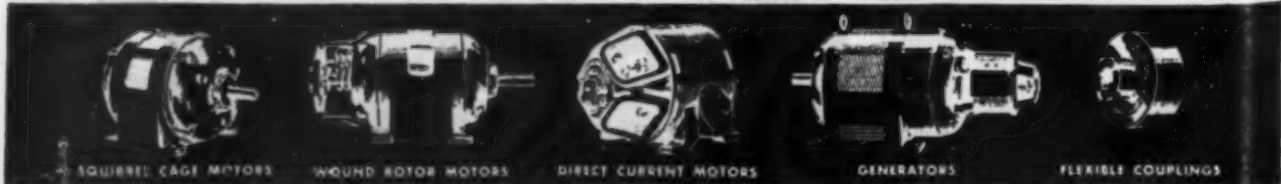


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CHEMICAL ENGINEERING NEWS

PRESIDENTS OF ENGINEERING SOCIETIES PRESENT PROGRAM FOR GERMANY'S POSTWAR ECONOMY

ON SEPTEMBER 29, President Roosevelt addressed a letter to the Foreign Economic Administrator outlining major policies as they will affect postwar Germany. He referred to the Department of State as the body which should direct the studies and the plans for determining what should be done after the defeat of Germany to control its capacity to make war in the future. He urged that this work be speeded up and that FEA cooperate fully with other agencies in bringing this about.

Considerable publicity had been given to a program unofficially credited to the Treasury Department which was said to propose the dismemberment of Germany and the reduction of its industries to a point where it would practically become an agricultural nation. For some months, presidents of some of the leading engineering societies of this country have been studying this question. They have been influenced by the publicity given in the press, to the Treasury plan to make public their findings.

Their statement says that on the basis of their experience in engineering and industry, they consider the proposal of the Secretary of the Treasury for the control of postwar Germany by the destruction or virtual dissolution of her industrial plant, to be economically unsound and to contain the seeds of a new war. They cite the part played by over 75,000 of their members in the design, engineering and production of the implements for our armed forces in quantities adequate for victory, as well as their long experience as engineering industrialists in peacetime, as entitling them to speak on this subject of paramount importance to the peace of the world.

Discriminating between peace and war economy, the statement points out that there are at least six industries which are the most essential for war purposes and the least essential for a peacetime economy. They are synthetic gasoline, manufacture of explosives, airplane production, use of aluminum and magnesium, high alloy and electric furnace steels, and nitrogen fixation.

The program specifically recommended reads: "Therefore, Germany's capacity to make war would be eliminated by the following steps in regard to its industrial economy:

1—"Eliminate all synthetic oil capacity and prohibit the reconstruction of plants and the importation of oil beyond normal peacetime inventories.

2—"Eliminate 75 percent of Germany's synthetic nitrogen plant capacity and prohibit reconstruction of plants and all importation of nitrogen compounds.

3—"Eliminate 50 percent of Germany's steel-making capacity in those categories

of plants which are most capable of producing essential war materials such as heavy forging, electric furnace and high alloy steels. Manganese, chromium, nickel and tungsten are practically non-existent in Germany. Also prohibit importation of iron ore, flux material, steel and steel products beyond normal peacetime inventories.

4—"Eliminate aircraft plants and equipment. Aluminum and magnesium are the raw materials required for airplane manufacture. There are no important bauxite deposits in Germany. Importation should be prohibited. Aluminum and aluminum plants should be destroyed and importation of aluminum ingots beyond prewar peacetime needs be prohibited."

The statement is signed by Malcolm Pirnie, president, American Society of Civil Engineers; Chester A. Fulton, president, American Institute of Mining and Metallurgical Engineers, Inc.; Robert M. Gates, president, The American Society of Mechanical Engineers; Charles A. Powell, president, American Institute of Electrical Engineers; and George Granger Brown, president, American Institute of Chemical Engineers.

STANDARD OIL DEVELOPMENT HOLDS ANNIVERSARY FORUM

COMPLETING 25 years of existence on Oct. 5, the Standard Oil Development Co., the central research organization of Standard Oil Co. (N.J.), celebrated the occasion by holding a silver anniversary forum at the Waldorf-Astoria, New York. The company decided that the most useful contribution it could make in commemoration of the anniversary was to sponsor a forum for discussions which will aid in forecasting the probable future responsibilities of industrial research and development organizations of all kinds.

Charles F. Kettering, General Motors Co., served as chairman of the morning

session of the forum and speakers included Dr. Frank B. Jewett, vice president, American Telephone & Telegraph Co., Thomas Midgley, Jr., president, American Chemical Society; and Harry L. Derby, president, American Cyanamid and Chemical Corp. At the luncheon, Col. Bradley Dewey, former Rubber Director, was the speaker.

In the afternoon, Warren K. Lewis, professor of chemical engineering, Massachusetts Institute of Technology, was in charge and addresses were given by Edwin H. Land, president, Polaroid Corp. Dr. Westbrook Steele, executive director, The Institute of Paper Chemistry, Lawrence College; Dr. Earl P. Stevenson, president, Arthur D. Little, Inc.; Dr. Clyde E. Williams, director, Battelle Memorial Institute; and A. C. Fieldner, chief, Fuels and Explosives Branch, U. S. Bureau of Mines. At the dinner in the evening, Frank A. Howard, president, Standard Oil Development Co., presided and introduced the Hon. Robert P. Patterson, Under Secretary of War, who was the principal speaker.

NATIONAL POWER SHOW WILL AID IN CONVERSION

WHILE plans of exhibitors at the 16th National Exposition of Power and Mechanical Engineering, which will be held at Madison Square Garden, New York, Nov. 27 to Dec. 2, originally were based on serving as an aid to war production, the favorable progress of the war has brought about some changes and many exhibits will be directed toward the shaping of reconversion plans. Every problem connected with the generation, control and application of heat and power in manufacturing is reflected in the displays.

A preliminary review of products that will be on display indicates that the following classifications will be well represented: heat and power production, distribution of energy, control appliances, auxiliary apparatus, instruments for indicating and recording measurements of quantities and pressures, power transmissions, material handling equipment, engineering materials, engineering specialties, and machines and tools.

CONVENTION CALENDAR

Association of Official Agricultural Chemists, Statler Hotel, Washington, D. C., Oct. 25-26.

American Oil Chemists' Society, annual meeting, Hotel LaSalle, Chicago, Ill., Oct. 25-27.

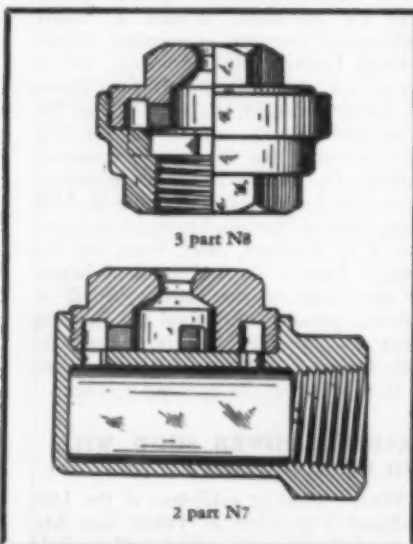
The Society of the Plastics Industry, fall meeting, Waldorf-Astoria Hotel, New York, N. Y., Nov. 13-14.

Third National Chemical Exposition, Chicago Coliseum, Chicago, Ill., Nov. 15-19.

American Institute of Chemical Engineers, fall meeting, St. Louis, Mo., Nov. 19-21.

Technical Association of the Pulp and Paper Industry, annual meeting New York, N. Y., Feb. 1945. Regular fall meeting will not be held this year.

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For Washing AIR-GAS-ACID

Due to simplicity of design and high efficiency operation . . . EDCO AIR, GAS and ACID Washing Spray Nozzles are used as standard equipment by nearly all manufacturers requiring a specified degree of atomization with a minimum of pressure.

EDCO NOZZLES are made in 2-part and 3-part models. The 2-part consists of body and cap containing an easily removable orifice, which eliminates elbow connections and reduces cost of installation.

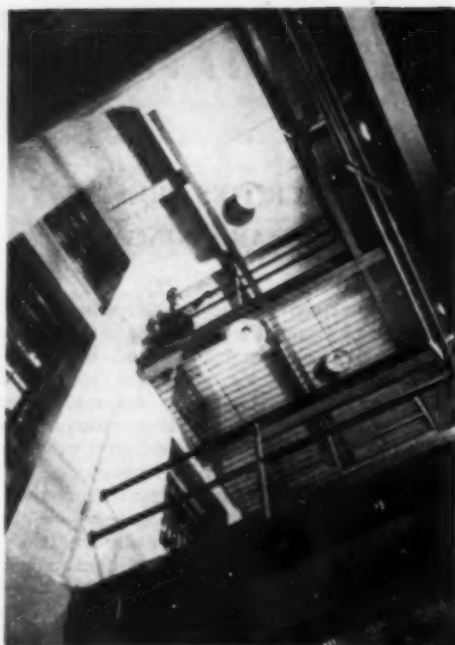
The 3-part EDCO NOZZLES have body proper with inlet connections directly in line with orifice openings, the cap containing the orifice and slots which serve to impart the flow of water uniformly entering the swirl chamber, and the flat disc which produces either solid or hollow spray.

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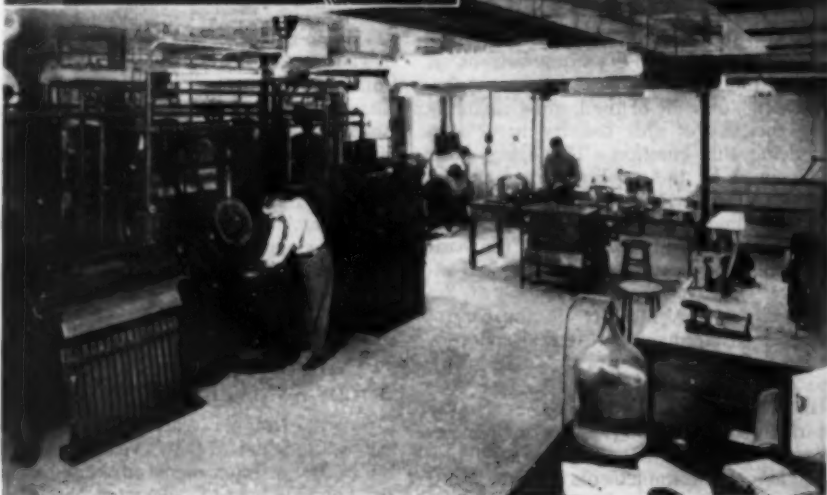
describing protection given by EDCO Nozzles and Strainers . . . yours for the asking! Contains detailed data on EDCO products, spray angles and capacity charts. Write for your copy today.

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A section of the pilot plant and laundry and dry cleaning laboratory of the Whitemarsh Research Laboratory, Philadelphia. On Oct. 4, following a luncheon to invited guests, Leonard T. Beale, president of Pennsylvania Salt Mfg. Co., turned the key of the laboratory over to Dr. S. O. Ogburn, Jr., manager of research and development and executive head of the laboratory. Charles F. Kettering, general manager of General Motors Corp., Research Laboratories Division, made a short address.



PROGRAM COMPLETED FOR CHICAGO CHEMICAL SHOW

WITH every foot of floor space available for commercial exhibits already engaged and with the program for the conference completed, the stage is set for the third biennial National Chemical Exposition and National Industrial Conference which will open at the Coliseum in Chicago on Nov. 15 and will continue through Nov. 19. The "Chemical Show" as it is more popularly called is sponsored by the Chicago Section of the American Chemical Society and will open on Nov. 15 with a joint luncheon at the Palmer House which will be attended by members of the Chicago Section and of the Chicago Association of Commerce. This will be featured by a discussion of "New Research Developments in Industry" with the speakers including Roy C. Newton, Swift & Co.; J. K. Roberts, Standard Oil Co. of Indiana; and Ernest H. Volwiler, Abbott Laboratories.

The Exposition is expected to draw attendance from a large cross-section of interests, including chemists, chemical engineers, bankers, educators, manufacturers

whose process in some way involves chemistry, and men holding technical and management positions. Many members of the American Institute of Chemical Engineers plan to stop in Chicago while enroute to their own meeting which will open in St. Louis on Nov. 19.

As an added feature, those present in the Coliseum on the evening of Nov. 18 will have an opportunity of hearing a special broadcast sponsored by Allis-Chalmers of Milwaukee. It will consist of a concert by the Boston Symphony Orchestra under the direction of Serge Koussevitzky and a dramatized salute to the chemical industry for the splendid job it has done in the war effort. The broadcast will be on the air from 8:30 to 9:30 Eastern War Time and will be carried throughout the nation by 189 stations of the Blue network.

The first session of the conference will be held on the evening of Nov. 15 when the speakers as previously announced will discuss metals. The sessions on Nov. 16 have been enlarged by the addition to the program of John F. Norton, The Upjohn Co., who will talk on "Research in the Production of Penicillin and Other Antibodies"; D. L. Tabern, Abbott Labora-

tories, whose subject will be "The Chemist Looks at Anesthesia"; and J. Collyer, president of B. F. Goodrich Co., who will discuss "The Chemical Engineer in the Synthetic Rubber Industry."

On the evening of Nov. 17, the November dinner meeting of the Chicago Section of ACS will be held and the principal speaker will be C. F. Kettering of the General Motors Corp.

KOPPERS WILL PRODUCE PHTHALIC ANHYDRIDE

A NEW chemical plant having a capacity to produce annually seven million lb. of phthalic anhydride will be built at Kobuta, Pa., according to announcement of J. N. Forker, vice president of Koppers Co. and general manager of the tar and chemical division.

Construction is to start promptly and the plant is scheduled to be in operation early next spring. Decision to build the plant at Kobuta, where Koppers United Co. now operates a synthetic rubber chemicals plant, follows the company's plan to establish an increasing amount of its chemical recovery equipment in the Beaver valley.

BAEKELAND AWARD FOUNDED BY NEW JERSEY CHEMISTS

ANNOUNCEMENT has been made by Horace E. Riley, chairman of the North Jersey Section, American Chemical Society, that the Leo Hendrik Baekeland award had been established by the Section to encourage creative talents of young American chemists. The first presentation of the award, which was instituted with the cooperation of the Bakelite Corp., will be made during May, 1945. It will consist of \$1,000 and a gold medal suitably inscribed. It may be presented biennially to an American chemist who has not reached his fortieth year, in recognition of accomplishments in pure or industrial chemistry.

MATHIESON ALKALI STARTS NEW AMMONIA PRODUCTION

PRODUCTION of ammonia from a new plant at Lake Charles, La., has been announced by George W. Dolan, president of the Mathieson Alkali Works. The plant is one of the two largest in the country producing ammonia from natural gas. Built by the Defense Plant Corp. and operated under lease by Mathieson, the new plant is fully engaged in war production, the ammonia being used to produce high explosives. After the war, the operation is expected to manufacture chemical fertilizers and anhydrous ammonia.

BATTELLE WILL CARRY ON NEW CORROSION RESEARCH

THE SERIOUS corrosion of pipes and fittings of high pressure condensate wells, which has cost the petroleum industry hundreds of thousands of dollars, will be studied by Battelle Institute, Columbus, Ohio, under a research program recently initiated for the Natural Gasoline Association of America.

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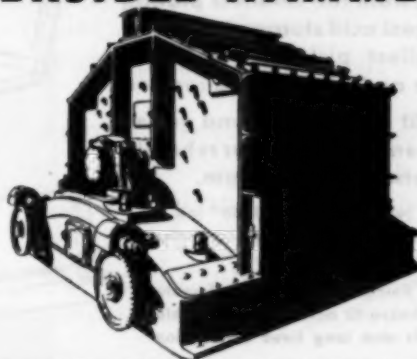
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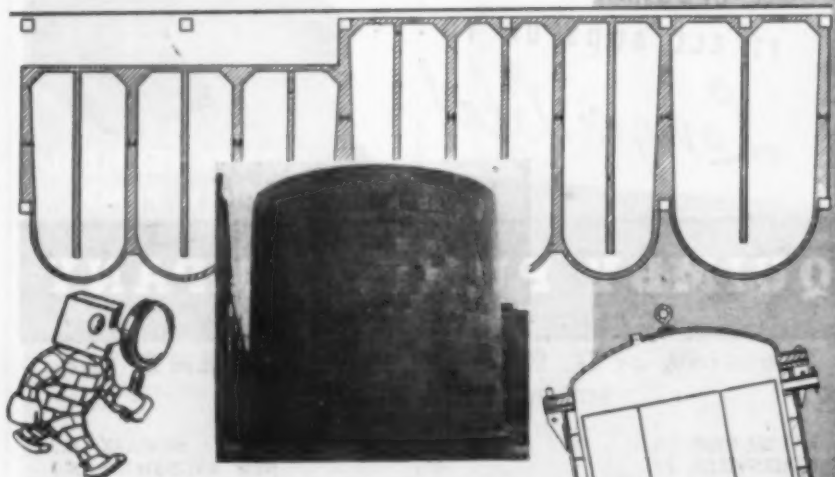
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During this period, we have successfully lined substantially every known type of process vessel, from the smallest plating tank to the largest acid storage tank; and from the smallest pickling vat to the most elaborate and complicated reactor. You can benefit by this long and varied experience when planning your rehabilitation or modernization program.

Every STEBBINS job is a "custom-built" job... designed to meet your individual operating and process requirements.

Every STEBBINS lining is constructed of materials carefully chosen to assure you a trouble-free, dependable and long lived installation.

Stebbins linings and tile tanks are installed in many of the outstanding chemical plants in the nation.

Every Stebbins job is covered by a lump sum contract, under which Stebbins supplies all required materials, all labor of installation and turns the completed lining job over to the customer ready for use.

One lining contract—one lining responsibility.



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UNIVERSAL OIL PRODUCTS CO. DONATED TO A.C.S.

OWNERSHIP of the Universal Oil Products Co. of Chicago, one of the leading research and development companies of the country, will pass to the American Chemical Society under the terms of a gift announced last month by Dr. Thomas Midgley, Jr., president of the Society.

The value of the Universal Oil Products Co. is estimated at from \$10,000,000 to \$15,000,000. Dr. Midgley said in addressing the members of the Society at their annual dinner at the Waldorf-Astoria. The income, which will be used for research under the direction of the Society, will be approximately \$1,000,000 a year, according to Dr. Midgley.

The Universal Oil Products Co. is owned by six of the nation's largest oil companies, including: Phillips Petroleum Corp., Shell Oil Co., Standard Oil Co., of California, Standard Oil Co. (Indiana), Standard Oil Co. (New Jersey), and the Texas Co.

When the gift is completed, the American Chemical Society will become 100 percent owner of the Universal Oil Products Co. The gift is made with the provision that the entire income therefrom shall be used by the Society at its discretion for research in the fields of science relating to the oil industry. Results of the research will be published and made available to the public without payment. The donors will have no rights to such results greater than those of the public at large. The Society will use the income to foster public welfare and education, aiding the development of our country's industries.

PILOT PLANTS FOR RUBBER POLYMERS BEING BUILT

FIVE synthetic rubber pilot plants are now under construction for leading rubber companies and are expected to reach completion early in the new year, it has been announced by the Blaw-Knox Co., designers and engineer-contractors of the quintuple project.

Development of new types of synthetic rubber polymers for further improving automobile tire and other synthetic rubbers is the overall purpose of the pilot plant installations. Plants are being built for Firestone Tire & Rubber Co., Akron; Goodyear Tire & Rubber Co., Akron; United States Rubber Co., Naugatuck, Conn.; Copolymer Corp., Baton Rouge, La.; and National Synthetic Rubber Co., Louisville.

ZINC REDUCTION PLANT MAY BE BUILT AT TACOMA

POSSIBILITY that a \$2,000,000 zinc reduction plant will be built at the smelter in Tacoma, Wash., in the postwar period was revealed recently by Eugene A. White, smelter manager, who said final approval of the plans would depend on officials of the American Smelting & Refining Co. of which the Tacoma plant is a unit.

A survey party headed by P. K. Richardson of Garfield, Utah, chief engineer of the smelting corporation, already has laid out the grounds for the proposed plant, which have been filled with smelter slag.

ANNUAL WATER CONFERENCE OF ENGINEERS' SOCIETY

THE Engineers' Society of Western Pennsylvania will hold its Fifth Annual Water Conference at the William Penn Hotel, Pittsburgh, Oct. 30-31. H. M. Olson is acting as general chairman. The program for the opening day includes papers on "Two Zone Methods for Operating Hydrogen Exchangers" by M. J. Shoemaker, Research Products Corp., Madison, Wis.; "Recent Experiences in Demineralizing Water" by M. E. Gilwood and V. J. Calise, The Permutit Co., New York; "Removal of Ammonia by Chlorination" by A. E. Griffin, Wallace & Tiernan, Newark, N. J.; "Once Through and Recirculating Cooling Water Studies" by Dr. H. L. Kahler, W. H. & L. D. Betz, Philadelphia; and "Cathodic Protection of Steel Equipment Submerged in Water" by L. P. Sudrabin, Dayton, Ohio.

Papers to be presented on Oct. 31 include "Water Treatment at Koppers United Company Plant, Kobuta, Pa." by Paul J. Stein, H. W. Howe, and F. B. Varga of the Koppers Co.; "Water Treating Problems in Steel Mills" by E. M. Griffith, Republic Steel Corp., Youngstown, Ohio; "Water in the Paper Industry" by Lewis B. Miller, chairman Water Committee, Technical Association of the Pulp and Paper Industry, Ambler, Pa.; "Lime and Limestone in Waste Pickle Liquor Treatment" by Richard D. Hoak and C. J. Lewis, Mellon Institute, and W. W. Hodge, University of West Virginia; "Ozone as a Water Sterilizer" by N. P. Rand, Norwood Filtration Co., Florence, Mass.; and "The Use of Silicates for Coagulation" by H. R. Hay, Philadelphia Quartz Co.

GLYCO PRODUCTS OPERATES PLANT IN MEXICO

THE Glyco Products Co., Inc., Brooklyn, announces the opening of a factory and offices in Mexico City. The Mexican company, known as Productos Quimicos Glyco, S. A., is located at Cipres Num. 355, Mexico D. F., Mexico, and is under the direction of Dr. E. Rios and Dr. A. Graf, both Mexican chemical engineers of considerable experience.

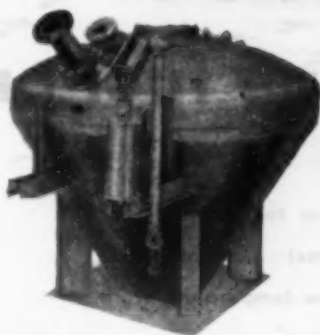
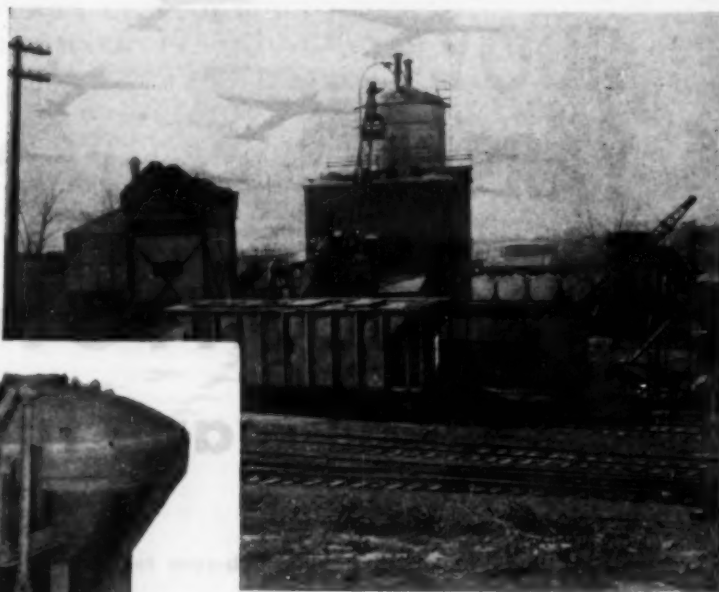
This company is manufacturing many of the products of the American parent company, particularly those which can be made from Mexican raw materials. It also acts as exclusive sales agents for all the other products manufactured by the Glyco Products Co., Inc., which are not, at present, being produced in Mexico.

HYGIENE FOUNDATION WILL MEET IN PITTSBURGH

THE NINTH Annual Meeting of members of Industrial Hygiene Foundation, an association of industries for the maintenance of healthful working conditions, will be held at Mellon Institute, Pittsburgh, the Foundation's headquarters, on Nov. 15 and 16.

More than 260 of the nation's leading industrial concerns, all of them producing for war, are affiliated with the Foundation and will be represented at the sessions.

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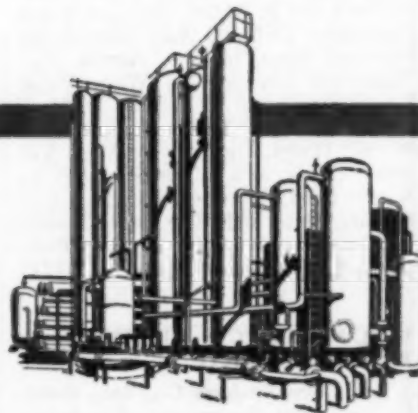
TO SPEED UP production of vital 100-octane-plus aviation fuel for America's aces, refiners developed alkylation processes which require temperatures from 80° to 90° below zero. Most of the refineries are located in warm climates. But even on the hottest summer days, outdoor pipe lines and towers must be operated at sub-zero cold.

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VARIOUS FACTORS WILL AFFECT POSTWAR DEMAND FOR AMERICAN CHEMICALS IN BRITISH MARKETS

Special Correspondence

THE QUESTION what prospects the British market will hold out to United States exporters after the war is one which has a profound bearing on the whole foreign business of the American chemical industry. For the British market is not only one of the most important and varied outlets for chemical and allied products abroad, but conditions for imported goods in England will, as in the past, be characteristic of those likely to be met in other countries. The United States has always been a favorite source of chemical products for British consumers.

The American share in the British market was increasing rapidly before the war when keen competition was met from continental Europe. Since the outbreak of war England has been cut off from her principal continental sources; it is certainly no exaggeration to say that without large supplies from the United States the chemical trades in the British Isles would not have been able to carry on. This fact is fully realized by English consumers. The speed and extent of American supplies has evoked the admiration of many British manufacturers, and the ease and matter-of-course way in which huge demands were met have left a deep impression.

Wartime experience has built up a very important goodwill in favor of United States producers. Their reputation for reliability, efficiency and adaptability will prove of great value after the war, especially where contracts for big quantities are involved. On the other hand, it is no less certain that careful costing will be needed under peacetime conditions for the British market, since this large market will receive the attention of many other suppliers.

In 1939 the United States accounted for £3,773,000 out of total British imports of chemical manufacturers from foreign countries of £13,771,000, and another £1,194,000 were sent to Britain by the Dominions and Colonies. Of the total increase of £4,290,000 in chemical imports between 1935 and 1939, the United States accounted for £1,875,000. These global figures, however, must be taken with more than a grain of salt. For one thing, they refer to manufactures as distinct from raw materials. Secondly, owing to the peculiarities of British foreign trade classification, they do not contain certain important items. Thirdly, a few outstanding items account for a fairly substantial part of the whole trade. If due allowance is made for these factors, there

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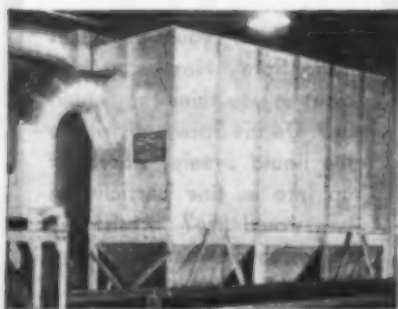
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still remains, however, the fact that the United States is one of the two or three most important suppliers of chemical products to England and that its share was increasing at a most gratifying rate.

American supplies enjoyed a monopoly in a few directions, e.g., in the case of carbon black (an item which in 1939 accounted for £789,000), of borax and boracic acid, and of turpentine. Paraffin wax, mineral jelly, and lubricating compounds were and are received in big quantities from the United States, as are, of course, petroleum derivatives in general. The American monopoly in the British import trade of these articles is not such that it could be exploited if this were desired, but it may be said with regard to these items that the future extent of British purchases will depend primarily upon the trend of demand and not to the same extent on their prices.

PHOSPHATES AND POTASH

Another important group of American chemical exports to England consists of articles like crude phosphates (of which the United States is the third important supplier besides Tunis and Morocco), essential oils (of which only France and Italy used to provide larger amounts), muriate of potash and caustic potash (which are also bought from continental Europe and Palestine) and a few other items. Here American exporters must compete with other foreign suppliers, and it is largely a question of prices and qualities to whom the lion's share in the British market goes.

As far as potash and phosphates are concerned, there are no sources of supply in the British Isles. The whole demand, likely to expand as more reliance is placed on home production of farm produce, must be met by imports, and it should be possible for American exporters to secure an adequate share of the British market. It is more than likely that the fertilizer deficiencies which have arisen under wartime restrictions on supplies will be made up by increased consumption after the war. Both phosphates and potash have been the object of effective control and production agreements, and the future of these markets will certainly to some extent depend upon the future of these cartels.

The American share in the British import trade of other chemicals, of proprietary medicines and drugs, of dyes, dyestuffs, intermediates and finished dyestuffs, of pigments and ready-mixed paints has also been very substantial, although it is difficult to single out for special mention the products in which these producers are most prominent. Acetone, bromides, nitrocellulose, disinfectants, glycol ethers, sodium chromate and bichromate, sodium phosphate, chestnut extracts and other items may be mentioned, but most significant is the fact that American products have found favor in so many different directions.

In some cases American gains in the English market were due to the cheapness of the raw material in the United States or to the fact that development in America has been faster because the need for the products had been more urgent. In other progressive production methods combined with the existence of a huge home market permitted rapid expansion where British

manufacturers had to probe their way cautiously. It is well to remember that British consumers, in spite of all their admiration for American drive and efficiency, demand individual attention from their prospective suppliers. The authorities on their side are on the principle of the opinion that in the case of important new developments British industries should be helped to participate in progress even at the cost of higher prices or subsidies. When, for instance, hydrogenation was applied to coal-oil production in Germany, the government helped a British firm to set up a coal-hydrogenation plant in the British Isles.

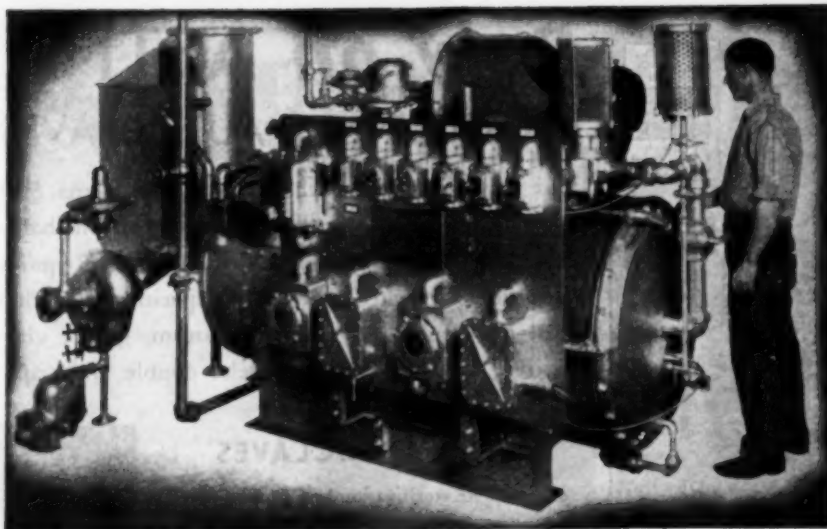
The vast expansion of synthetic rubber production in the United States did not restrain the British authorities from supporting a British producer's project in this field of activity. Moreover, the authorities have given their full support to research and development by financing official studies, granting tax relief for private research, and encouraging collective development work under the aegis of trade associations.

IMPORTANCE OF RESEARCH

British manufacturers and consumers of chemical products have indeed become very research conscious. There is a growing realization of the possibilities of building up manufacturing industries on the basis of domestic raw materials. The organic chemical industry is bound to expand considerably after the war, there are plans for a British oil refining industry, metal smelting in Britain has been supported at least partly because it provides a basis for chemical production, and it is hoped to start some electrometallurgical and electrochemical plants on the basis of hydroelectric power or of electricity generated from coal.

In their entirety these projects cannot but decisively influence the trend of the chemical industry. On the other hand, England's economic future is so closely bound up with her foreign trade and exporting industries that their interests will never be neglected. But these industries, too, expect and demand a great deal of research assistance and individual attention from their suppliers, such as normally only the man on the spot can give. They are conservative by nature. While they are not unwilling to make experiments and take risks, they will not allow themselves to be talked into new ventures without being given some pretty sound arguments. On the other hand, once they are satisfied that it is worth their while to listen and buy the offered article, they will not change their supplier for the sake of a few cents which they might save by buying elsewhere.

Cooperation between British and American manufacturers has been satisfactory to both sides in the case of agreements between the big firms, but smaller manufacturers have found it somewhat difficult to make use of potential opportunities in the other country. There is also a case for more cooperation between research workers and organizations. At the moment the whole question of industrial and scientific research is still rather fluid, but there is no doubt that a great deal of waste could be eliminated by more cooperation.



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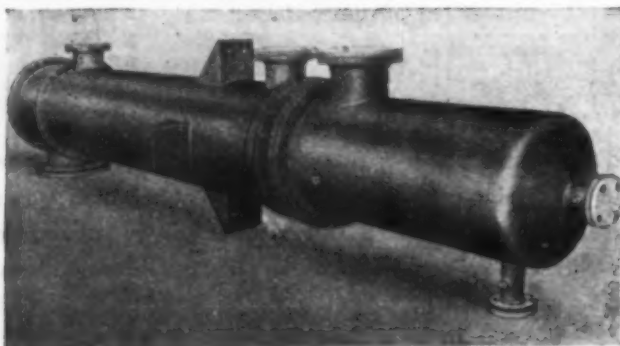


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Among British firms there is a growing realization of the need for mutual exchange and pooling of ideas and methods on a national scale. In some fields, abstracting of scientific papers for instance, international arrangements have been suggested, and there is certainly much scope for cooperation in this field. As far as production and sales are concerned, special organizational facilities would probably be necessary to make it easier for smaller firms adequately to cover the market of the other country.

In Britain trade associations have played such an important and successful part in adapting small firms to wartime needs that one might expect them to be equally active when the time arrives for the change to peacetime conditions. It is to be hoped that the evident wish of British manufacturers to cooperate with their opposite numbers in the United States will meet with a favorable reception.

NEW CHEMICAL PRODUCTION REPORTED IN PERU

THE Foreign Commerce Weekly in a brief summary of chemical developments in Peru in 1943 states that plans for production of zinc oxide, zinc sulphate, potassium carbonate, and borax were the principal developments of the year. Productora Peruana, S. A., started manufacture of zinc sulphate last year and will produce copper sulphate, potassium carbonate, and borax this year. It is expected to produce 200 metric tons of zinc sulphate this year with zinc and sulphuric acid being supplied by the Cerro de Pasco Corp. Its probable output of copper sulphate is placed at 200 tons with borax and carbonate of potash expected to be produced this year to the extent of 30 tons each.

RUSSIA INCREASES OUTPUT OF CHEMICALS

THE OUTPUT of chemicals, particularly for war purposes, has increased substantially in the Soviet Union. Production of the nitrates, plastics and organic chemical branches rose continuously in 1943. The index figure during the second quarter of the year was 126.5, the first quarter of the year equaling 100. Index for the third quarter was 135, and for the fourth quarter, 139.5. The nitrogen industry, producing ammonia, nitric acid, and ammonium, sodium and potassium nitrates held first place. Production of sulphuric acid by the contact method showed a considerable increase.

NEW TECHNICAL RESEARCH INSTITUTE IN SPAIN

A NEW technical research institute at Barcelona, Spain, has been granted an initial subsidy of 125,000 pesetas by the Council for Scientific Research. The organization will be concerned with greater utilization of domestic raw materials and will furnish technical assistance in connection with the establishment of new industries or the modernization of existing ones.

BARITE TO BE PRODUCED IN BRITISH COLUMBIA

BARITE is to be produced in British Columbia under arrangement completed by the British Columbia and Yukon Chamber of Mines. The Summit Lime Works at Lethbridge, Alberta, has discovered and developed a large deposit at Parson, B. C., a short distance south of Golden, in the East Kootenay district. The deposit is described as being about 20 ft. wide, extending for a considerable length. For some time small quantities of barite from this deposit have been used in Turner Valley, in the process of drilling oil wells. A contract has been let for 60,000 tons to be sent to Vancouver to be used as ballast for 20 special maintenance ships under construction. The barite is reported to be nonmagnetic, impervious to salt water, and not to disintegrate.

MEXICO PRODUCES OIL FROM MONILLO SEED

MONILLO seed oil is reportedly used in Mexico in the manufacture of soap and also in cosmetics, pomades and delousing preparations. The seed grows in the States of Durango, Sinaloa, and Zacatecas, but the largest amounts come from Tamaulipas and Nuevo Leon. Estimates of real or potential production vary from 300 to 4,000 or more tons annually. The collecting season varies with the locality, but in general lasts from August to October. The problem of pressing seeds, however, is difficult as crushers are said to be reluctant to adjust their machines unless they are assured of substantial quantities of seeds.

EXPORTS OF SWEDISH PULP DROPPED LAST YEAR

THE DOWNWARD trend of Swedish wood pulp exports continued throughout 1943 and total shipments which dropped to a new low of 434,000 metric tons in that year showed an aggregate decline of more than 80 percent from 1939 exports of 2,331,000 metric tons. Mechanical pulp was the most adversely affected item, exports in 1943 amounting to only 8,000 metric tons, or 2.5 percent of the prewar quantity. Although reduced production activity paralleled reduced exportation, a surplus of 415,000 metric tons of unsold pulp was still on hand at the end of 1943, four times more than is normally held in reserve.

ARGENTINA MAY PRODUCE COPPER SULPHATE

AFTER considerable study of the problem caused by insufficient supplies of chemical products for agricultural use, Argentine government technicians have suggested that domestic production of copper sulphate be undertaken. Plans call for the establishment of a national industry at Mendoza which would use locally available raw materials. The project would require a large number of producers since the needed quantity could not be manufactured by a few concerns.

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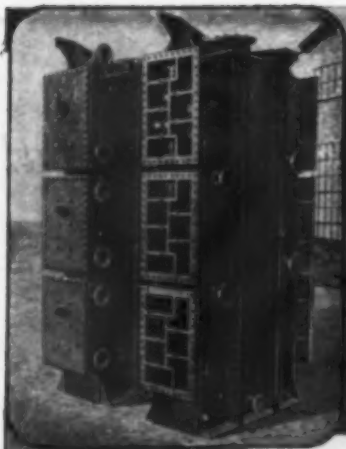
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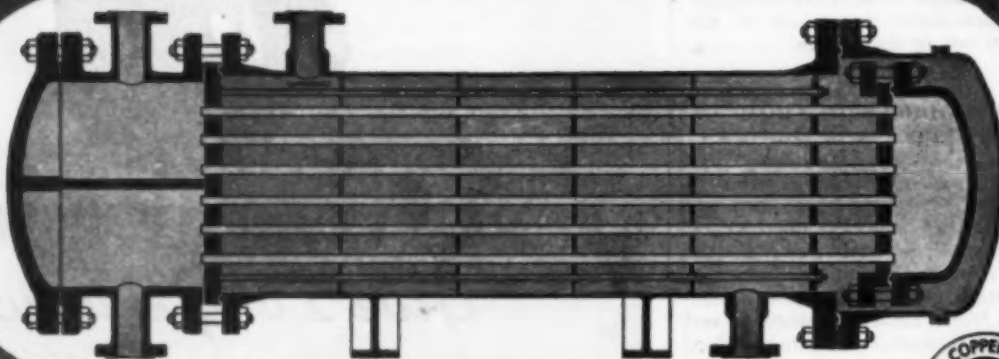
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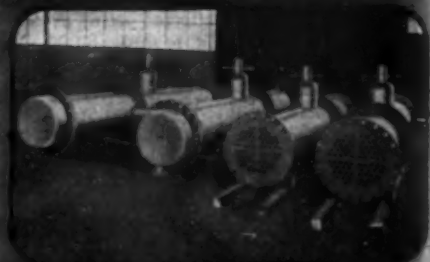
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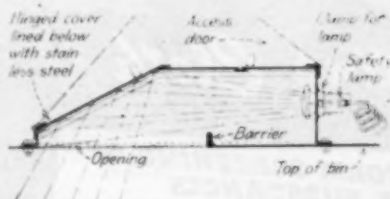
FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN, Engineer

EVERY SUGAR BIN has to have a gate at the outlet. From time immemorial these gates have been of the sliding variety. With a heavy load on top and tacky syrup on the slide, the gates resist movement except under the encouragement of a crowbar or a sledge hammer. On the other hand the quadrant gate concentrates its load on an easily rotating shaft and, even with 60 ft. of sugar above, it operates comfortably. Louvers are provided above the gates for access in case lumps should bridge over the neck. The same gates serve satisfactorily for coal or cinders. When the gate is set for a desired rate of flow to the minglers, the opening may be smaller than the lumps that come down during cold weather and accordingly the flow plugs. To permit wider opening of the gate without increasing the flow a bent plate is installed below the gate as shown. The angle of repose then controls the rate of flow and the lumps are pushed through by the weight in the bin. This plate can also be hinged for adjustment.

Illuminating the interior of a refined sugar bin is safely accomplished by reflecting light by means of a polished stainless steel mirror. This removes the prejudice of having electric light globes within explosive distance of the sugar.

HOPPER BOTTOMS of the wet sugar bin were built when the customers demanded coarse grain. When the predilection swung to fine grain, the bottom of the hoppers was too flat for even flow to the dryers. The fine-grain sugar sometimes flowed sluggishly out of the four hoppers and so a man at a near-by station who had just barely enough to do to keep himself awake was ordered to keep his eye on the flow. If the man's wakefulness and

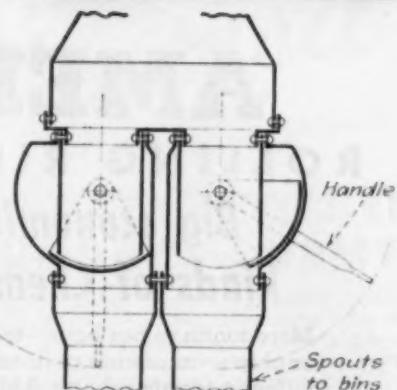


Broken glass cannot get into bin

the interruption of flow happened to synchronize, a poke from the hickory bar caused resumption of movement. However, the man showed no enthusiasm for the additional duty, contending that another man should be added to the payroll. Furthermore, the application of the poker brought down an intermittent avalanche while the desire was for an even flow to maintain the full capacity of the dryers. Accordingly the poker was replaced with electric vibrators, and thereafter the only poking required was by the foreman's finger when he poked in the push button. The vibrators are now widely used on a great variety of "constipated" bins and chutes. They have the effect of decreasing the angle of repose. When the first vibrator was installed on the soft sugar hopper, the operator forgot to shut it off when he closed the gate. A half-hour later when he opened the gate he found the neck packed as with concrete. An ordinary barrel holds 370 lb. of granulated sugar. The same barrel subjected to an electric vibrator took nearly 500 lb. of sugar and then burst.

THE BOTTOM of the coal bunkers has a slope of 45 deg. A wedge of coal clings to the bottom to make a slope of about 50 deg. or more to satisfy the angle of repose. This wedge of coal remains dormant until it starts to smoke three to six months later. An application of dry ice snuffs out the fire until time permits complete cleaning out. A year ago a vibrator was installed which gives promise of avoiding spontaneous combustion. The period of vibration is 3,600 per min. and the amplitude is adjustable between $\frac{1}{16}$ in. and $\frac{1}{8}$ in. Vibrators are also made portable for use in unloading hopper-bottomed gondola cars delivering recalcitrant materials like wet coal. The electric power demand for the four vibrators on the wet sugar hoppers, known as size V-127, is 3 kw. The cost of this as byproduct power is \$0.01 per hr. while it releases a stubborn workman at \$0.75 per hr.

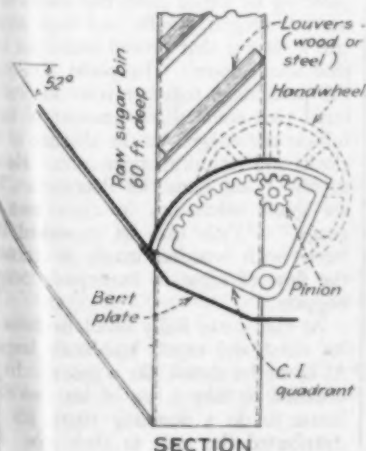
SPOUTS from bins are too small an item to attract the attention of the professors of hydraulics. The sheet metal shop fore-



Typical installation shows quadrant gates used to handle sugar or other materials which would jam the slides of a sliding gate

man determines the design from the fullness of his experience. For soft sugar that possesses a certain stickiness, the spouts should be vertical and larger at the outlet than at the inlet. Stainless steel facilitates flow and is used especially in scale hoppers where a quick discharge is desired. Following a brainstorm, we installed an inclined pipe with six branches dropping out of the bottom to supply packing machines below. The purpose was to replace a scraper conveyor which received its supply from the refined sugar bin two stories above. The pipe would be a simpler thing and we reproached ourselves

Detail of quadrant gate assembly



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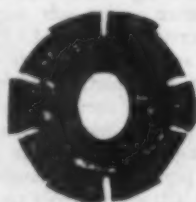
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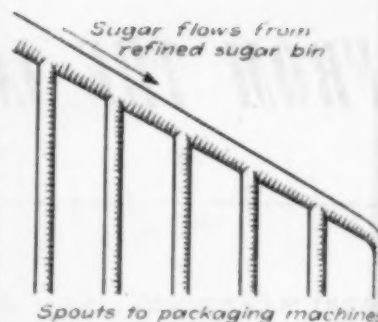
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Arrangement of pipes which were supposed to simplify the distribution of sugar to packaging machines

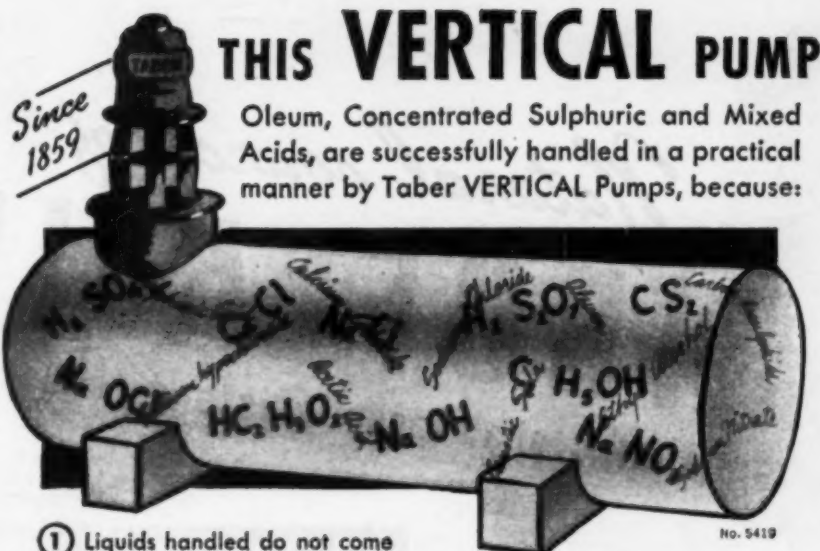
for not having thought of it earlier. The gang finished the installation on Sunday night and were criticized for falling short of the schedule which had included the removal of the old conveyor. On Monday morning the wreckers were about to start abolishing the conveyor when the foreman came breathlessly bringing six cartons of sugar filled from the respective machines. Each package contained a different size of grain, the last one being the largest. The pipe acted like a classifier, the coarse crystals rolling over the top. All of them had, of course, been covered in fresh physics but had become lost. Facts, like jokes, require to be restated at intervals of at least a generation. In the meantime, by special favor of Providence, the old conveyor was still intact and was promptly restored to service so that production was lost, while the brainstorm was forthwith eradicated before the office broadcaster got wind of it.

SHEET METAL WORK was formerly conducted under the supervision of Charlie Kelly. He possessed unusual skill as an artificer in sheet metal. He was a small-time contractor operating a shop in his cellar. His accounts were kept in a vest pocket. There existed no talent in the refinery at that time for descriptive geometry, and accordingly the art of developing the complicated spouts and inspired mystification. Thus Kelly was opportunely into the sheet metal job the comfortable basis of "cost-plus," and he accepted orders informally just as a refinery attaché would. Whenever a came up he would order the sheets to nearest integral bundle and thus accumulate a surplus that proved useful for jobs about town. His profit constituted the percentage together with surplus material plus some slight amount of foolfulness encouraged by the absence of clocks and technical supervision. He used to say, "God bless the Polanders. They are good mechanics in their own language." With this he furnished freely with wooden mauls to encounter the flow of sugar in improperly designed hoppers.

At the works Kelly loved to throw his chest and expell bombastic language. At home he shrank like a mouse. He occasion to take a few of his men to house to do a domestic repair job. He distributed the men to their jobs.

ently his wife came in and disposed the work according to a plan of her own. She had windows to clean and other household drudgery. When Charlie remonstrated on the ground that it was not seemly from economic considerations to employ mechanics for house cleaning, she pointed the threatening finger at him and blurted, "Kelly, you may be boss at the Sugar House but you ain't boss here!" Kelly died in 1926 in front of a taxi as he tried to beat it to a cigar stand.

HERMAN ZITKOWSKI'S TERRITORY as manager of the American Crystal Sugar Company extends from Minnesota to California. As a school boy of fourteen he craved a job in the Norfolk, Nebraska beet sugar factory in '94. The boss stationed him at the molasses scale in the Steffen process where he incidentally harmonized the babel of languages among the assortment of immigrants from France, Germany and Poland. Herman's stipend was 7½ cents per hour, equal to half the wage of a full-grown workman or a third of the honorarium of an expert. The mysterious performance of chemist Pete Baird fascinated him and he wanted to be just like that! The manufacturing "campaign" in Nebraska starts in September and ends in December, after which everybody is laid off except a few perennials who are retained for the maintenance and improvement of the works. The surplus men return to their farms. Herman went back to school. In the summer the factories had no job but Herman hung around. He observed that the common water bucket was a stationary device, occasionally re-filled from a well 500 feet away. When high-priced mechanics craved water, they dropped their work and got it. Herman drew the attention of Superintendent J. McCoy Williams (descendant of Roger) to this wastefulness. It impressed J. McCoy seriously and, after the manner of the times, he presented the matter for official deliberation. In due time Herman's suggestion received managerial approval and a precedent was established with Herman in the berth of water boy at five cents an hour. During the Cleveland depression, when farmers bartered eggs and butter for calico and shoes, this was important money. A chicken on the hoof could be exchanged for a pound of sugar. However, the mechanics appreciated the luxury of the peregrinating water bucket. Herman thus became well acquainted with the anatomy of the apparatuses and, beside, built up muscular agility. Phlegmatic Pete Baird urged expeditiousness with his bucket so as to leave some time between rounds which Pete promised could be invested in the laboratory. Thus Pete got his dishes and errands done effortlessly and Herman enjoyed the stimulation of the laboratory atmosphere. This led to a "position" when the campaign opened in the Fall as laboratory roustabout at thirty dollars a month. He then began alternating between gainful work and school. At 22 he returned from a year of post graduate work at the famous German Sugar Institute of Braunschweig. He had ten dollars, a master's degree and a job.



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NAMES IN THE NEWS



Fred Grotts

Fred Grotts, president of the H. K. Porter Co. subsidiary, Fort Pitt Steel Casting Co., has been appointed to the newly created position of director of research and metallurgy for all Porter plants. He will continue as president of Fort Pitt.

William Blum, chief of the Section of Electrochemistry, U. S. Bureau of Standards, was the recipient of the eighth Edward Goodrich Acheson Medal and Thousand Dollar Prize awarded by The Electrochemical Society. Dr. Blum received the award and prize at the Society's annual fall convention October 13.

R. P. Russell, executive vice president since 1937, has been named president of the Standard Oil Development Co. to succeed **F. A. Howard** who resigned October 6. Mr. Howard will remain a director of the Development Co., and a vice president of the Standard Oil Co. (N. J.) until after January 1, 1945, when he expects to resume the private practice of law. **W. R. Carlisle** has been named a vice president of the Development Co.

William Goodman, consulting engineer for the Trane Co. in LaCrosse, Wis., has been appointed research professor of refrigeration and air conditioning at Illinois Institute of Technology. Mr. Goodman will begin his new duties in November.

John F. Daley has been appointed general manager of the Pigments Department of E. I. du Pont de Nemours & Co. Mr. Daley succeeds the late **Carl H. Rupprecht**.

J. Warren Kinsman has been named general manager of the Fabrics and Finishes Department of E. I. du Pont de Nemours & Co. Mr. Kinsman succeeds **William Richter** who retired October 1. **William Kirk**, manager of the Chambers Works at Deepwater Point has succeeded Mr. Kinsman who formerly was assistant general manager of the company's organic chemicals department.



Van M. Darsey

Van M. Darsey, formerly technical and service director of the Parker Rust Proof Co., Detroit, has been elected president of the company and a member of the board of directors.

Almon G. Hovey, formerly at the University of Minnesota, has been made head of the New Chemical Development Section of General Mills, Inc., Research Department, Minneapolis.

John Charles Garey was recently appointed to direct the research and production program on a new nutritional yeast by the Red Star Yeast and Products Co., Milwaukee. He was formerly with Hiram Walker & Son, Peoria, Ill.

S. A. Karjala, formerly at the Northern Regional Research Laboratory, Peoria, is with Central Soya Co., Decatur.

Edward G. Locke has been appointed to the position of chemical engineer on the staff of the Pacific Northwest Forest and Range Experiment Station, Portland, Ore. Dr. Locke will specialize in the engineering phases of the chemical utilization of wood.

David F. Smith has been appointed director of the laboratories of Johnson & Johnson, New Brunswick, N. J., replacing **G. S. Mathey**, vice-president, whose recent illness has necessitated his relinquishing direction of the company's activities in chemical and clinical research, product and process development and quality control.

Robert J. Goodrich has been promoted from assistant manager to manager of the Chambers Works at Deepwater Point plant of E. I. du Pont de Nemours & Co. Mr. Goodrich succeeds **William Kirk** who has been appointed to the position of assistant general manager of the Organic Chemicals Department. **Samuel Lenher** has been named to succeed Mr. Goodrich at the Chamber Works.



Wilbur A. Lazier

Wilbur A. Lazier has resigned as research group leader in the Chemical Department, E. I. du Pont de Nemours & Co., to become director of Southern Research Institute which will establish laboratories at Birmingham, Ala. In his new position Dr. Lazier will be responsible for the development of a comprehensive research program for advancing technology in the southern states.

Elmer K. Bolton, chemical director of E. I. du Pont de Nemours & Co., has been elected to receive the Perkin Medal. The medal is presented by the American Section of the Society of Chemical Industry. Presentation will take place January 5 and is in recognition of Dr. Bolton's accomplishments in industrial research.

Charles W. Perry has left his position of chief, Polymer Development Branch, Office of Rubber Director, to accept appointment as analyst for new processes, Chemicals Division, Phillips Petroleum Co., Bartlesville, Okla.

Robert R. Cole, vice president of Monsanto Chemical Co. and general manager of the Phosphate Division, has been elected a member of the Board of Directors. Mr. Cole fills the place on the board left vacant by the recent death of **John C. Brooks**, vice president and general manager of the company's plastics division.

Gustav Egloff of Universal Oil Products Co. has been elected a director of the Chicago Technical Societies Council.

John W. Boyer has left his position with the War Production Board to establish a private consulting practice.

Howard J. White and **James S. Denham**, managers of the Rayon and Acetate Divisions respectively, have been appointed to newly-created positions of Assistant Managers of the Rayon Department of E. I. du Pont de Nemours & Co. **Frank**

BOOTH 80

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B. Ridgway was named manager of the Rayon Division, succeeding Mr. White, and Willis Shackelford succeeded Mr. Denham as manager of the Acetate Division. Charles A. Cary, assistant manager of the Nylon Division, has been named division manager to succeed E. K. Gladding who was recently appointed director of the Development Department.



A. Kenneth Graham

A. Kenneth Graham and C. A. Crowley have announced the formation of Graham, Crowley and Associates, Inc., as consulting electrochemists and engineers. Offices and laboratories of the new organization will be in Chicago, Ill., and Jenkintown, Pa.



C. A. Crowley

M. G. Werme, formerly superintendent at the Clinton, Mass., plant of the Wickwire Spencer Steel Co., has been appointed chief development engineer of the company. Gordon Lloyd has been appointed superintendent at the Clinton plant, and Victor Chartner has been named chief mechanical engineer.

E. J. Finkbeiner has been named a vice-president of American Car and Foundry Co. He will continue in the operating department.

Olin H. Philips has been placed in charge of laboratory metallurgical research work of all American Car and Foundry Co. plants, to succeed John W. Steinmeyer who has been transferred to the New York Research Department.

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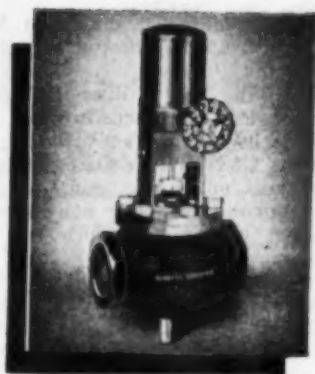
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Leonard H. Cohan

Leonard H. Cohan has been appointed director of research for Continental Carbon Co. Dr. Cohan will be in charge of Continental's Chicago and Sunray, Texas, activities.

Arthur C. Lansing has been promoted by Reichhold Chemicals, Inc., to the position of manager of research and assistant to the director. Other newly appointed department heads at Reichhold are: P. Stanley Hewett, director of research, Chemicals Division; C. John Meeske, director of research, Coating Resins Division; Clinton A. Braidwood, assistant director of research, Coating Resins Division.

Maximilian Toch, president of Toch Bros., Inc., and vice-president of Standard Varnish Works, Inc., has been elected an honorary member of the American Institute of Chemists.

Emile F. du Pont, Nylon Division production director of E. I. du Pont de Nemours & Co., has been named assistant manager of the Acetate Division. Robert A. Ramsdell has been named assistant manager of the Nylon Division, and G. W. Filson, assistant manager of the Rayon Division.

Thomas S. Chambers, formerly associated with the Standard Oil Development Co., has assumed duties as manager of chemical research and engineering for the A. B. Dick Co. of Chicago.

George F. Temple has joined the technical staff of Foote Mineral Co. Philadelphia. Mr. Temple was formerly with the General Chemical Co., leaving as technical supervisor and control chemist.

Russell H. Lasche has been appointed director of engineering and research for the Fairchild Camera & Instrument Corp. of New York.

Arthur W. Sloan, rubber chemicals research head of The B. F. Goodrich Co. has left for Cairo, Egypt, to take up duties as chief of chemical allocations in the Middle East for the Foreign Economic Administration. He expects to return to Goodrich at an early future date.

Leo R. Kiley has been appointed Detroit

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George W. Potter, director, executive vice-president and general manager of the Eagle-Picher Mining and Smelting Co., and G. C. Niday, Tri-State manager of mines and mills, have retired to devote their attention to other non-competitive personal interests, in which they have been associated for many years.

Frederick C. Nachod has resigned from his position in the Research Division of the Permutit Co. to accept appointment as senior chemist in the Research and Development Department of the Atlantic Refining Co. He will be located in the Research Laboratories at Point Breeze, Philadelphia.

OBITUARIES

Carl H. Rupprecht, 57, general manager of the Pigments Department of E. I. du Pont de Nemours & Co., died September 10, at East Orange, N. J., after an illness of several months.

Leo Frank Goodwin, 66, professor of chemical engineering at Queens University, Kingston, Canada, died August 15.

Philip Howard Stott, 52, chemist associated with the Technical Laboratory of the Dyestuffs Division, E. I. du Pont de Nemours & Co., died in the Delaware Hospital, Wilmington, August 28.

Harold Albert Smith, 50, president of The Smith Agricultural Chemical Co., Columbus, Ohio, died at his home on August 30.

Clifford J. Stothers, 66, secretary of the Pfaunder Co., died September 7.

Dwight L. Armstrong, 50, vice-president of the Armstrong Cork Co. died September 10 after an illness of four weeks.

H. O. Chute, 77, chemical engineer who aided in perfecting equipment and processes used in wood distillation, died September 19 in New York.



Walter S. Landis

Walter S. Landis, 63, vice-president of the American Cyanamid Co., died suddenly September 15.

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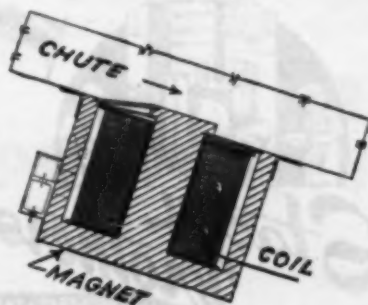
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In all practicable sizes to fit conveying systems or in self-contained separator units with tail pulley, belt, sturdy frame, with or without casters. (Bulletin 302.)

Magnetic Drums—Have wide use where pulleys may not be advisable by reason of space restrictions, conveying set-up, etc., for instance, in reconditioning hot foundry sand to save belts; in paper making operation ahead of hogs while conveying trimmings, leaching of ore for mining operation; tramp iron removal from flow in feed and grain mill processing, to cite only a few.

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INDUSTRIAL NOTES

The M. W. Kellogg Co., New York, has opened a new office in the Mellie Esperson Bldg., Houston, Texas with W. T. McCay in charge.

Raybestos-Manhattan, Inc., The Manhattan Rubber Mfg. Division, Passaic, N. J., has appointed Littleton C. Barkley sales manager of the mechanical rubber goods sales department. He has been serving as manager of the New York office and will make his headquarters at 120 Broadway, New York.

Lukens Steel Co., Coatesville, Pa., has named William S. Wilbraham production manager. George L. Snyder chief engineer of Lukenweld has been made assistant to the general manager.

Allis-Chalmers, Milwaukee, has placed Frank C. Angle in charge of field sales offices of the general machinery division. He will continue to supervise operations in the Pacific Coast area.

The Duriron Co., Dayton, Ohio, has elected D. E. Jack vice president in charge of engineering and sales. R. C. Schenck has been elected vice president in charge of production.

General Controls, Glendale, Calif., has moved its New York factory branch to

101 Park Ave., New York. John Hammond is branch manager. The Cleveland office with L. E. Wetzell in charge is now at 3224 Euclid Ave.

Gaybex Corp., Nutley, N. J., has made John B. Moore general manager of the corporation.

Adhesive Products Co., Seattle, Wash., has begun production of phenol-formaldehyde resins for use in plywood and related products.

Tennessee Eastman Corp., Kingsport, Tenn., is now handling the sale of its manganese sulphate. Carlot shipments will be made from Kingsport but stocks will be held at different distributing points.

Corn Products Refining Co., New York, has appointed A. N. McFarlane manager of the chemical division.

Economy Pumps, Inc., Hamilton, Ohio, has elected E. E. Quimby and Frank H. Gaylord commercial vice presidents. Mr. Quimby will specialize in sales transactions for large projects too involved for a resale agency and Mr. Gaylord will promote sales in the new wholesalers division.

E. I. du Pont de Nemours & Co., Inc., Wilmington, has made Warren A. Beh

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ENGINEERS • FABRICATORS • RECOGNIZED EXPERIENCE & FACILITIES

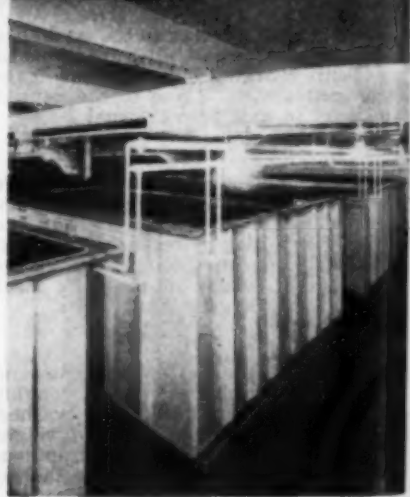


Photo shows an installation of Stacey Brothers
Special Processing Tanks.

PRESSURE VESSELS

director of sales for nylon. George S. Demme, district sales manager for rayon in the New York office succeeds Mr. Beh as assistant director of nylon sales.

S. C. Johnson & Son, Racine, Wis., has appointed Ray W. Carlson sales manager with headquarters at Racine; John H. Hurley, manager of the product finishes department; James W. Barrett, Jr., manager of the maintenance products division; Walter A. Bridgemen, manager of field research in the research and development division; and Harvey W. Blankenship, industrial sales promotion manager.

Robins Conveyors, Inc., Passaic, N. J., announces that William B. Mercer, who had been loaned to WPB, has returned to the Boston office where he will handle sales in the New England territory.

Omega Machine Co., Kansas City, Mo., has moved its factory and offices to 9 Codding St., Providence, R. I. L. E. Harper, president of the company will be located at 122 S. Michigan Blvd., Chicago.

Crane Co., Chicago, has appointed Lucien W. Moore manager of the valve and fitting sales department with headquarters in the main office. He is succeeded as purchasing agent by Thomas J. Hanlon.

Western Electric Co., New York, has moved David B. Peckham into the position of comptroller of manufacture to succeed the late John M. Stahr. Clifford W. Smith has succeeded Mr. Peckham as comptroller of sales.

Niagara Sprayer and Chemical Co., Middleport, N. Y., has taken over the Coastal Chemical Co., Inc., Harlingen, Texas, and will merge its operations with their own.

Worthington Pump and Machinery Corp., Harrison, N. J., has moved William J. Van Vleck from Philadelphia to manage its office in Atlanta.

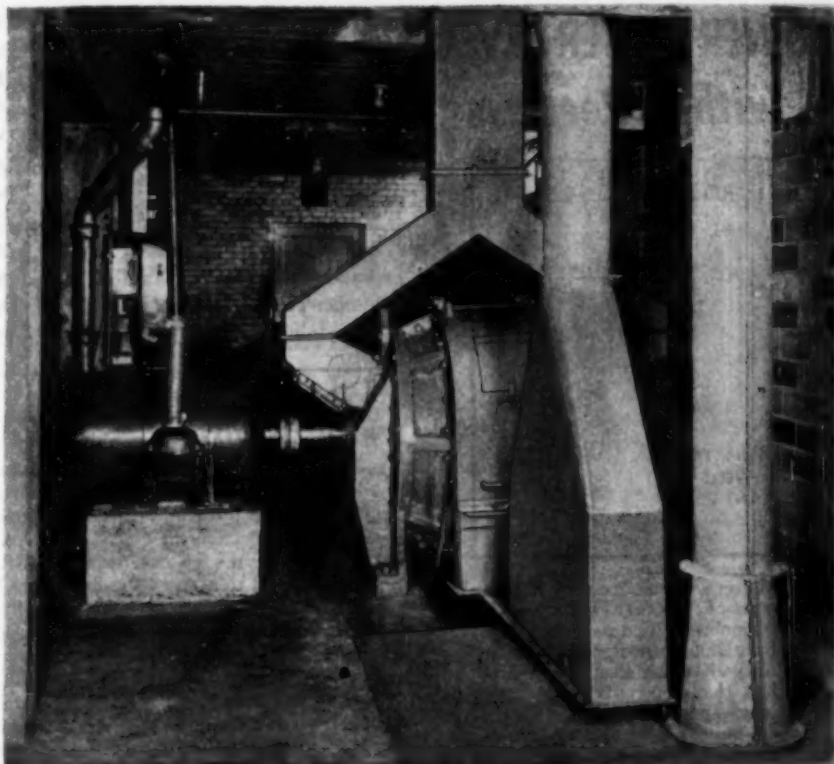
Allegheny Ludlum Steel Corp., Pittsburgh, has purchased the property in St. Louis which it has been using as a branch office and warehouse.

Carrier Corp., Syracuse, N. Y., announces that Frederick W. Smith of WPB will join the corporation about Nov. 1.

The Carborundum Co., Niagara Falls, has appointed F. Jerome Tone, Jr., vice president in charge of sales. He succeeds senior vice president Charles Knupfer who has been assigned to special sales and executive activities. Vice president Henry P. Kirchner will be in charge of production and Otis Hutchins will act as technical director in charge of research and process control and development.

Hercules Powder Co., Wilmington, has opened a new office in the Union Commerce Bldg., Cleveland, to handle western sales for the synthetics department. W. Wallace Trowell will be manager of the new branch and John L. Present will serve as technical representative.

NEW FIELDS DEMAND NEW DEVELOPMENT



IF GRINDING IS INVOLVED

THE extension of existing processes to new fields usually brings with it specialized problems.

New uses for new products requires their complete acceptability in both chemical and physical properties.

The application of extraction processes now in extensive use in the Soybean industry to other oil bearing products will doubtless bring new needs for grinding of raw, semi-finished or finished materials. This is a field in which Prater has wide experience.

Prater Service for the Process Industries is organized to meet your present and future needs in any phase of processing in which grinding or mixing is involved.

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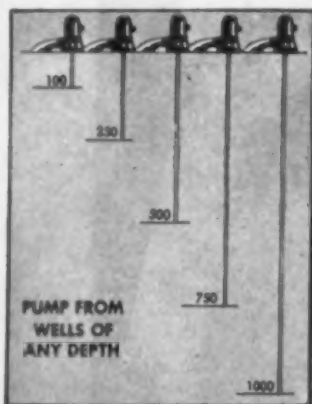
Brown & Sites Company

50 Church Street, New York 7, New York

TAP

LOWER WATER LEVELS

with a Peerless



Water levels are receding in many parts of America. This critical situation was discussed most forcefully in a recent issue of The Saturday Evening Post. It's a problem that confronts many pump users—perhaps you.

To tap the lower water levels you need a Peerless Deep Well Pump. Look ahead. Make provision for a dependable source of water for years to come by going deeper for your water. Peerless Pumps will lift water from any depth and can be installed to meet the receding water levels. Some are installed more than 900 feet deep.

Peerless Pump heads are designed and engineered to carry the load. The Peerless Moturbo Head, with its built-in, hollow-shaft motor, water-cooled, over-size bearings and the shaft with oil or water-lubricated bearings, insures economical operation and high efficiency.

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CONVENTION PAPER ABSTRACTS

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REINFORCEMENT OF GR-S WITH ZINC OXIDE

EXPERIENCE accumulated in compounding zinc oxide in natural rubber has been of little aid in realizing satisfactory properties with zinc oxide in GR-S. The reinforcing properties of zinc oxide in GR-S are influenced to a much greater degree by the proper balance of accelerators, softeners, and sulphur than natural rubber compounds with zinc oxide.

Many experimental elastomers of the butadiene-styrene type have been evaluated with zinc oxide. From the standpoint of zinc oxide reinforcement, the most striking effect is produced by the amount

and nature of the organic acid portion in the rubber. Elastomers low in fatty acid, for example, develop much higher stress-strain properties than the regular polymer containing approximately 6 percent fatty acid. Similarly, a rosin soap polymer has been found distinctly superior to GR-S when compounded with zinc oxide.

The combination of accelerator and sulphur has a major influence on the stress-strain properties of high zinc oxide compounds. The inorganic accelerator, magnesia, in conjunction with a small amount of a fugitive accelerator has yielded satisfactory stress-strain properties. An improved formulation was found in a combination of Trimene base, magnesia, and a coumarone indene resin. Laboratory tests indicate that these materials with 15 volumes of zinc oxide will yield a compound of distinct merit in respect to stress-strain and heat build-up characteristics.

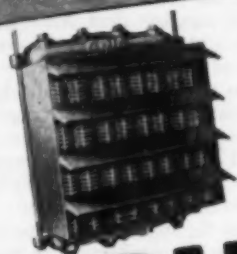
H. C. Jones, New Jersey Zinc Co. (of Pa.), before Division of Rubber Chemistry, American Chemical Society, New York, April 26-28, 1944.

SOLVENTS FROM FARM RESIDUES

FARM residues such as corncobs, sugarcane bagasse, flax shives, oat hulls, and cottonseed hulls may be converted by a new process into sugars suitable for the manufacture of such industrial solvents as ethanol, furfural, butanol and acetone. The process is a two-stage operation in which the pentosans are first hydrolyzed by dilute acid, after which the cellulose is

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WITHSTANDS
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Fumes of HCl...*

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**HIGH TEST
Cast Iron
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★ One piece construction heating sections (patented) of high test cast iron that withstands steam pressures up to 250 lbs.

★ No soldered, brazed, welded or expanded connections to become loose or develop leaks.
★ No electrolysis to cause corrosion, breakdowns, leaks, or heating failures.

That's why GRID Unit Heaters will withstand the corrosive fumes in chemical plants without maintenance. As one Midwest chemical plant reports, "The materials used in its fabrication are ideal for providing corrosion resistance." After 8 years of continuous operation another chemical plant reports, "We have found cast iron construction stands up very well against the corrosive fumes of HCl, Cl₂, etc. and there has been no maintenance on the units. We certainly recommend GRID for installation where corrosive fumes exist." Is it any wonder that chemical plants are installing GRID Unit Heaters? Complete data and capacity tables upon request.

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The same high efficiency and lasting qualities as GRID Unit Heaters... one piece construction "Bn" sections of high test cast iron... no tortuous air passages... complete absence of ruptures, strains, and warping. Guaranteed for steam pressures up to 250 lbs. Complete information upon request.

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BECAUSE...

CAPACITY: Fletcher baskets are larger—they hold more—and the ease with which they are unloaded and reloaded, ready to go again, is an added advantage.

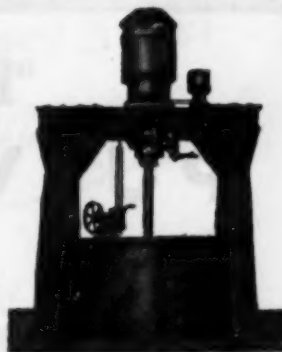
SPEED: Quick acceleration and higher speed result in increased output—more quantity with no sacrifice in quality of work.

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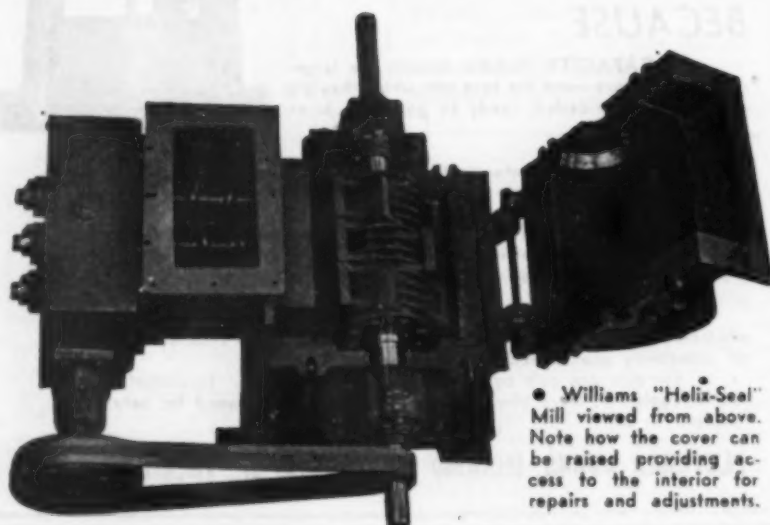
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- GRIND WET OR STICKY MATERIALS
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• The Helix-Seal Mill grinds extremely fine without the aid of outside separation. This is largely due to the long grinding surface, adjustable grinding parts and high speed of the hammers. Due to the screw feeder which acts both as a feeder and seal, sealing the intake opening against the in-rush of air, no air is sucked into the machine and consequently there is no resulting dust carrying draft expelled from the discharge. Built in nine standard sizes, capacities 200 pounds per hour and up.

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saccharified by a new concentrated-acid process that uses less than one-fourth the amount of acid required by known concentrated-acid processes.

By means of the process, relatively pure separate solutions of 5-carbon sugars and 6-carbon sugars are obtained from farm residues. The solutions have a sugar content of 10 to 15 percent, which is then used in industrial fermentation. The separation of the sugars makes it possible to use them for the production of the most profitable chemicals—industrial alcohol, butanol, and acetone from the 6-carbon sugars and furfural from the 5-carbon sugars.

A semi-works plant is to be constructed to try out the process on a large scale. It will be capable of producing about 2,000 lb. of dextrose, 1,800 lb. of xylose (equivalent to about 800 lb. of furfural), and 1,000 lb. of lignin per day. The 6-carbon sugars produced will be fermented to ethanol or to butanol and acetone in the existing fermentation pilot plant of the Northern Regional Research Laboratory which has a capacity of 500 gal. of 10 percent ethanol per day. The 5-carbon sugars will be used as a source of pure xylose or distilled with acid to produce furfural. By the joint operation of the two plants it will be possible to determine the practicability of the process and operating costs.

J. W. Dunning and E. C. Lathrop, Northern Regional Research Laboratory, before Symposium on Sugars from Wood, American Chemical Society, New York, Sept. 14, 1944.

VAPOR PHASE GUM IN MANUFACTURED GAS

THERE is reason to believe that vapor phase gum has always existed in manufactured gas and that it was the use of automatic equipment for fuel purposes that caused the problem originally to assert itself and to increasingly press its importance. From the standpoint of fuel uses, the existence of the problem was established as long ago as 1930, when, at least one rather large situation, gas refrigerators showed an annoying genius for failing to function, as the result of the deposition of a dark substance on the adjusting needle. The existence of the substance was established on other automatic equipment and in other properties until its prevalence has been practically generally recognized.

Almost immediately after the existence of the problem was established, work was undertaken to determine the nature of the substance causing the trouble and the mechanics of its formation. And it was determined that the substance was a gummy material deposited from the gas. It was also established that its formation resulted from the now well-known interaction of the gaseous compounds NO, CO, and unsaturated hydrocarbons. (Hence, a common description as vapor phase gum.)

Two of the characteristics of the gummy particles so formed were their minute size and astronomical number. Their size varied from molecular up to approximately 0.00008 in., and their number has been estimated as ranging from 20,000 to 100,000 per cc., or a maximum of nearly 3,000,000,000 per cu. ft. in an ordinary gas giving

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objectionable but not excessive gum trouble. It was determined that, because of the small size of these particles, they had the property of remaining suspended in moving gas for an indefinite period, with the result that, once having formed, they would be certain to go throughout the entire system and be in a position to affect any piece of automatic equipment anywhere on the lines. Despite their minute size, their great number, combined with the extremely small annular openings (estimated in some cases as 0.00028 in., assuming the annulus is truly concentric) of pilot adjustment devices, results in an amount of difficulty that is, from the customer's standpoint, insupportable.

Work done by various sources indicated that it was possible to remove in the plant a substantial proportion of the NO, thus reducing the amount of vapor phase gum formed, but dust and other suspended matter in the gas, including vapor phase gum remaining after treatment, still cause trouble with automatic equipment. The two general methods for eliminating the gross conditions in the plant are the use of an electric gum treater and manipulation of the purification boxes so as to have a certain amount of iron sulphide available to react with and extract a substantial portion of the NO.

It was impossible to eliminate all or enough of the difficulty in the plant. Further, since there seems to be no likelihood of anything being developed to sufficiently control the problem in the plant, it became necessary to devise means of protecting the small flows which control the automatic equipment. This led to considerable development work and the use of such devices as the thin plate orifice and filter, of which latter there are at least two which will effectively remove vapor phase gum.

Satisfactory handling of the vapor phase gum problem would then fairly clearly seem to call for elimination of gross conditions in the plant by appropriate NO control methods (this should insure for proper protective devices a life greater than that of the average appliance) and the general use of a proper protective device.

H. D. Lehman, Philadelphia Gas Works, before American Gas Association, New York, June 6, 1944.

SETTLEMENT OF CLAIMS UNDER CONTRACT TERMINATION

It is roughly estimated that there are in excess of a million war contracts, the vast bulk of which are subcontracts; altogether there are probably in the neighborhood of 70 thousand plants either partially or totally engaged in war production. A comparatively small proportion of these have contracts directly with the government of the United States.

At this time there may be uncertainty as to when there will be cut-backs or changes, or cancellations. But one thing is certain, that sooner or later the time will come when mass cancellations will be unavoidable. Orders will issue that will cancel and terminate many thousands of these contracts. Advance notice of cancellation will have come to the prime contractor, who is then obligated to transmit it to his subs. They will have promptly sent it down to the sub-subs until it will

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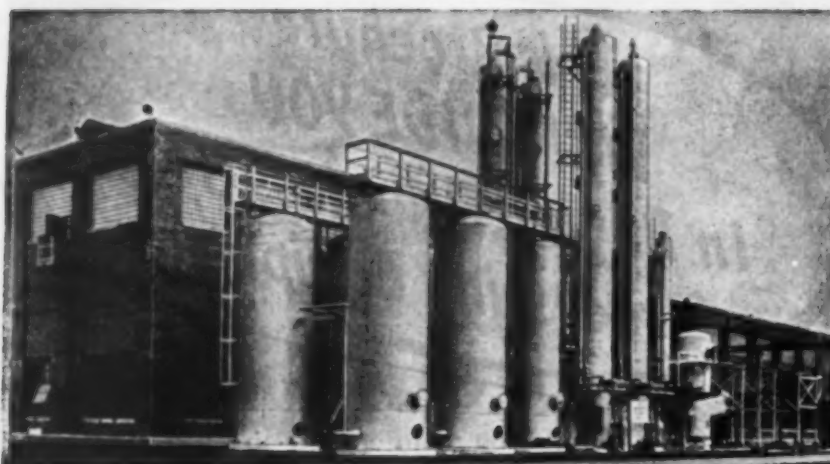


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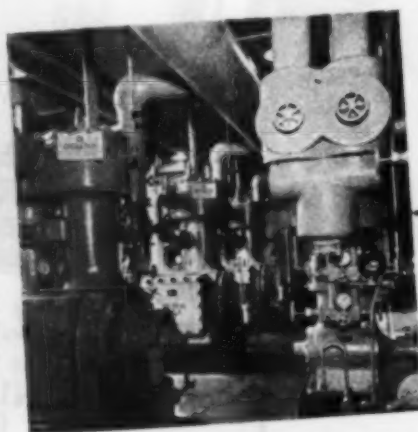
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PENICILLIN PLANT

At this Commercial Solvents Corporation plant, production of penicillin by the deep-fermentation process is in full swing. In this highly specialized industry, as in power plants of public utilities and industry in general, reliable Carey Insulations are standing firm guard against temperature variations, preventing heat losses and making possible, maximum power production from minimum fuel. For details, write Dept. 15.

Fermentation tanks where mold from which penicillin is obtained, is grown by the new "deep culture" process. All of these tanks are insulated with Carey materials.



Ammonia refrigeration room—Carey Insulated. Compressors furnish about 375 tons of ammonia-system refrigerant for storage, freeing, and cold processing.

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have reached the last tier of subcontractors including many hundreds, if not thousands, of producers and suppliers on the particular contracts.

Experience over the past year in canceling more than 18 billions of authorized expenditures has taught us many of the pitfalls. When the first V-day comes and cancellations are issued affecting about 40 percent of our war production, the average plant engaged exclusively in that production will cease its operations, the owner of the plant, whether he be contractor or sixth tier subcontractor, will find his funds invested and tied up in materials and inventories, in labor and overhead, in finished and unfinished products. His plant may be clogged up with his inventory, he will probably be indebted, at least for his current obligations; most of them, if they follow instructions and notify their subcontractors, will find themselves indebted to their own subcontractors for claims on these terminated contracts. A profound change will take place, which, unless promptly cared for and guarded against could have far-reaching effects on business, industry, and employment.

Preparations by the government alone will not and cannot be expected to do the job. The government may be, and is ready to accord fair compensation for the cancellation, but it cannot be expected to do so if you, as a manufacturer, do not know, or are not in a position to know, the underlying facts, which would constitute the basis for fair compensation. The government cannot know what the amount of your claim is until you have presented it. You are part of a group which may be working on one government contract and the longer you may delay in presenting your claim on that contract, the longer you delay the settlement, not only of your claim, but possibly of the claims of many others.

The essence, the spirit, the ultimate purpose of the Contract Settlement Act is to provide fair compensation to all war contractors whether they are on top of the heap and are called prime contractors, and have a contract directly with the government, or whether they are in the tenth or twentieth tier of sub-contractors.

The government can, and does, take the position that if any contractor in the chain makes a reasonable and just payment to the subcontractor so as to provide him with fair compensation for the cancellation, the government will foot that bill, if it is not excessive and not tainted with collusion or fraud. Fair compensation to all war contractors whether prime or sub or sub-sub, because of cancellation, is the keynote of the Contract Settlement Act of 1944.

Second only to that consideration are the provisions for interim financing. All of the contracting agencies including the Smaller War Plants Corporation, have been authorized to assist in this interim financing and the law specifically declares that financing of this type must be furnished within thirty days after an application is made on such a claim.

Negotiation and settlement of claims frequently requires time, discussion and adjustment. Pending that delay, the government agencies will make partial pay

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ments on account of your termination claim which will compensate you at least to 75 percent, and perhaps as high as 90 percent, depending very largely on the state of your own records, the cleancut presentation of your claim, the listing of items with a reasonable degree of accuracy.

Broadly speaking, your compensation will include 100 percent of the contract price for finished articles for which you have not been paid. Secondly, the actual cost of partially manufactured items. Thirdly, the actual cost of any raw materials, including tools, jigs, dies, fixtures, that you may have acquired for the job. Fourthly, the claims of your own sub-contractors, and finally the incidental costs of working out the settlement.

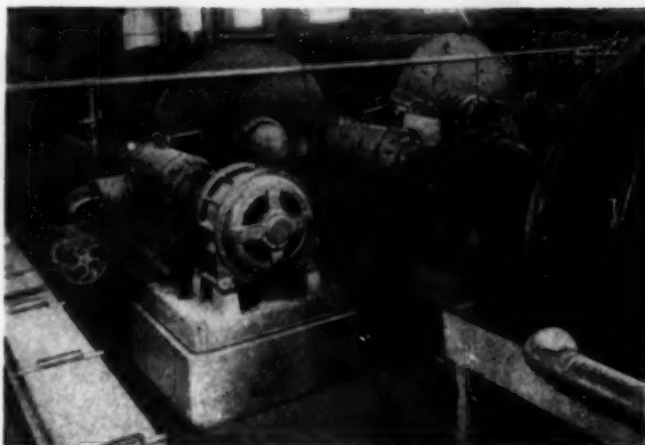
As far as is humanly possible, keep your government business separate and apart from your private civilian business. Another suggestion—conduct your business on the assumption that cancellation day is coming tomorrow, and within a week or ten days or sooner, if possible, you should be in a position so that you can tell your contractor or the government "I have so many articles completed, and under the contract I am entitled to be paid their full purchase price. I have so many partially completed articles which, in material, labor, and overhead, have cost me blank amount of dollars. I have materials on hand which cost me so many dollars. I have computed my overhead expense fairly apportionable to the uncompleted items; I have computed the cost and reduced value of my tools, jigs, dies and fixtures, and that amounts to so many dollars; and I am out of pocket for clerical and accountant and lawyer's charges in this amount." Present that claim to your own contractor. Ask for a partial payment if you wish. Ask for a loan on your claim, if you wish. Or better still, see your contractor and make a fair and reasonable trade with him on your claim. And if you cannot get relief from him, go either to the contracting officer in charge of your contract; if you do not know who he is, or where to turn to, you come directly to the nearest office of the Smaller War Plants Corporation.

David Podell, Smaller War Plants Corp., before Metal Fabricating Industry in the Metropolitan Area, New York, Sept. 15, 1944.

PIGMENT INCORPORATION IN GR-S THROUGH LATEX

INVESTIGATION of the relation between the characteristics of various fillers and their reinforcing properties in GR-S has shown that the particle size of the filler is the most predominant characteristic associated with its reinforcing ability. In a quantitative way, however, several exceptions to this rule were observed in milled GR-S stocks. Fine zinc oxides and whittings do not yield compounds with the physical properties which their particle size and distribution indicate they should in comparison with carbon blacks and clays. Since it appeared that this was due to lack of proper dispersion of these fillers in the elastomer means were sought to obtain more complete dispersions of fillers in GR-S. To attain this, a water dispersion of pigment was mixed with GR-S latex and the pigment and polymer were coagulated simultaneously. The

High Volumetric Efficiencies at All Vacuums



Three Fuller Rotary Vacuum Pumps, capacity each, 1280 c.f.m. at 25-in., used for withdrawing water from slurry in a cement plant.

Fuller Rotary Vacuum Pumps have many advantages which set them apart from other types. In addition to their high volumetric efficiencies at high vacuums, they have the following features:

Small size with relation to capacity; absence of vibration and pulsations adapt them for installation where other types might be objectionable. Continuous rotary motion; few and totally enclosed working parts; direct drive at motor speeds. Elimination of valves, reciprocating parts and complicated mechanism keep maintenance costs at a minimum.

Fuller Rotaries, single and two stage, are available in a full range of capacities to 2000 c.f.m. displacement; for vacuums to 29.90 in. (referred to 30-in. barometer.)

Write for Bulletin C-5, illustrating and describing these machines.

FULLER COMPANY

CATASAUQUA, PENNSYLVANIA

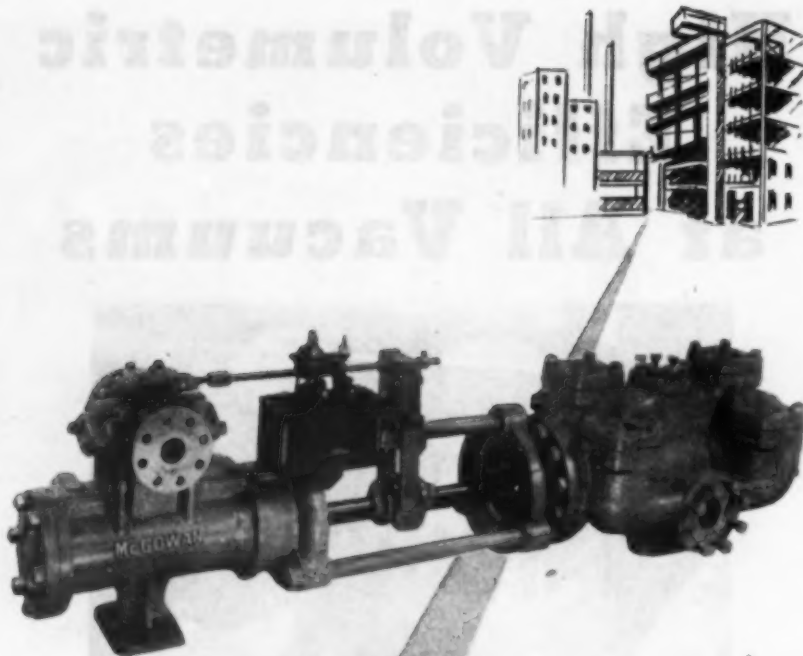
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Our Engineering Department is available for information on installations and requirements. While we have designed our equipment with the best features possible, suiting the large majority of users, we recognize the fact that some engineers lean toward other methods, which they sincerely believe to be the best construction, and which our designs may differ in a few small details. We will be glad to construct pumps to meet your specific requirements.

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process has been employed with zinc oxides, calcium carbonates, and carbon blacks and compounds prepared with such master batches have all had tensile strengths and moduli which were superior to the corresponding mill-mixed compounds. Other properties which have been measured are hysteresis, cut growth resistance, heat build-up, and electrical characteristics and again the latex dispersed compounds were found to be superior in a general to mill-dispersed.

This work indicates that through incorporation of reinforcing pigments in GR-S by coagulation with the polymer in the latex stage, substantial improvements in stocks can be realized and in addition an increase in the productive capacity of present rubber processing machinery and a large saving in power would result.

W. McMahon and S. R. Kamp, Bel Telephone Laboratories, before Division of Rubber Chemistry, American Chemical Society, New York, April 26-28, 1944.

POSTWAR OUTLOOK FOR GALVANIZING

QUITE naturally, we cannot sit back complacently and expect the postwar markets to come to us. Further, we cannot depend too much on the pent-up markets to keep us occupied for too long a period. Some of these unsatisfied markets may already have been absorbed, to some small extent, by other new products; and, most certainly, the time will surely come when these pent-up demands will have become exhausted and we will be on our own. New products have been developed during the war by necessity and we must recognize that products may have been discovered which will prove themselves worthy to take the place of some galvanized products. This is normal development and indicates the American spirit of competition on which this country has thrived and grown great. In a contest for markets, as in any other contest, someone must lose and probably some galvanized products have already lost out permanently to new types of products. We can have no objection if the new products have proved to be better than the old galvanized products which they have replaced.

The galvanizing industry is challenged to maintain its position in the field of coated products. With a background of more than a century of producing such products, during which time these products have proved their value to the extent that they are widely and confidently accepted by the buying public, we are not too much alarmed. We know the merits of zinc-coated products and we shall also enter the spirit of free competition to the extent that we may hope to gain new fields which were not formerly ours for zinc-coated products. We know that the product with the most quality, at the most economical price, will win. We are aware that we must produce better products and different kinds of products to meet the changing demands. We must be ever alert to changing markets and changing requirements, and we must keep abreast through intelligent research. We are certain that our quality products must also be cheap and we would suggest that it will always be desirable to procure zinc metal for coatings at the lowest possible price—the

h zinc nearer the price of zinc to the price of the steel base, the better.

With the fundamental and inherent merits of zinc as a coating metal as a background, with better quality, low price, and new developments which are coming from research, the galvanizing industry is definitely setting out to increase its markets after the war.

Nelson E. Cook, Wheeling Steel Corp., before American Zinc Institute, St. Louis, April 18, 1944.

USE AND FUNCTIONS OF PILOT PLANTS

CONVERSION of laboratory data handed down from the pure research group into plant design data is one function of the pilot plant. Such a task requires the setting up of a definite program, including a thorough investigation of basic reactions and reactants, time, temperature, concentration and catalysis factors, a study of raw materials, operations needed, control specifications, safety and health hazards, etc., investigated with the thoroughness and zeal of a pure researcher, but with the viewpoint of a chemical engineer. The pilot plant in such cases is a research unit.

The pilot plant also must provide the breakdown of a process into unit operations, selection of suitable equipment, savings of materials, equipment, time, labor, and also a study of wastes, their recovery or disposal.

After a new plant or process is designed, the pilot plant continues investigations of problems which require the elimination of the compromise acceptance of data, without which compromise a delay might be involved in plant construction.

Operating processes use the pilot plant as the trouble-shooting division, when trouble shooting is not being carried on, the pilot plant is doing development work along lines of alternate raw materials, improvement of products and byproducts, lower costs, safety, bringing the plant up to date, etc.

The proper personnel in a pilot plant is the most important feature of its success.

Frank C. Vilbrandt, Virginia Polytechnic Institute, before Division of Industrial and Engineering Chemistry, American Chemical Society, New York, Sept. 11, 1944.

STUDIES IN EMULSION POLYMERIZATION

EMULSION polymerization processes are considered to occur in two distinguishable steps: dissolution of the monomer into the aqueous phase and polymerization of the monomer in the aqueous phase.

Step 1 has been studied by observing the behavior under the microscope of single small drops (0.3 to 0.8 mm. diameter) of organic liquids submerged in soap solutions. In sodium oleate and sodium laurate solutions the diameters of drops of styrene, 2, 3-dimethylbutadiene, benzene, toluene, ethylbenzene, mesitylene, and carbon tetrachloride, decline linearly with time until over 99 percent of the drop passes into the aqueous phase. During the dissolution both phases remain microscopically clear. The "dissolution rate" expressed in ml. transferred per sq. cm. of interface per min. is independent of the drop size but varies with the nature of the



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organic liquid, temperature, and composition of the soap solution. These observations are explained on the basis of a diffusion process involving the solubilization of the organic liquid by the soap.

Potassium persulfate in the soap solution enhances the dissolution rate of styrene and, to a lesser extent, that of 2,5-dimethylbutadiene. This effect is attributed to the increased concentration gradient of monomer brought about by polymerization of the solubilized monomer.

In a variety of synthetic emulsifying agents the drops of the organic liquids listed contract as in the soap solutions. Simultaneously, however, fine droplets of the organic liquid appear in the aqueous phase in the neighborhood of the drop. These accumulate until the opacity of the emulsion obscures the original drop.

J. R. Vinograd, L. L. Fong and W. M. Sawyer, Shell Development Co., before Division of Colloid Chemistry, American Chemical Society, New York, Sept. 13, 1944.

AMERICAN POTASH INDUSTRY MEETS ITS WARTIME TEST

IN MEETING the potash requirements of the nation's fertilizer and chemical industries, as demonstrated by its current performance, the American potash industry has now attained the goal which it assumed as an entirely voluntary obligation in planning its contribution to the nation's war effort. Since 1939 it has increased its annual deliveries from 312,000 tons K_2O in that year to 711,000 tons K_2O in 1943, a rate of progress which shows no slackening in 1944.

In addition to the needs of the United States, Canadian requirements are being supplied on terms of exact equality with our own and exports are being made to our "good neighbors," the Republics to the south of us and to even more remote friendly nations.

During this period the requirements of the chemical industries have increased from 15,000 tons K_2O in 1938 to some 100,000 tons currently and Lend-Lease exports have been made to the United Kingdom, now replaced by supplies from Spanish sources. During the fiscal year, 1944-45, the American industry proposes to provide for all these purposes a total of some 890,000 tons K_2O to be delivered in the form of over 1.6 million tons of potash salts, of which high grade muriate, potassium chloride, will exceed one million tons.

Of particular interest to the fertilizer industry is the prospective supply for agriculture in the United States, Puerto Rico and Hawaii of 750,000 tons K_2O , for the so-called fertilizer year, 1944-45, of which 640,000 tons were subject to allocation by the War Production Board during Period 4, and the balance during Period 5.

Since the fertilizer industry is at present the sole retailing agency for agricultural potash, this tonnage is subject to allocation and constitutes the supply for our war food program. This is to be distributed to the farmers of the nation principally as a constituent of mixed fertilizers during 1943-44 amounting to 74 million tons. Lesser amounts are retailed as potash salts, in former years estimated at 10 per

cent of the total, but last year amounting to only a fraction of that percentage.

The adequacy of this supply is indicated by the fact that it provides 75,000 tons K_2O for retailing as potash salts and 685,000 tons K_2O for mixed goods, sufficient for an 8.5 percent K_2O average content of 8,000,000 tons, the probable limit on mixed-goods output under current labor conditions. The attainment of any one of these accomplishments means a record-breaking achievement in line, however, with what the nation expects.

While this unprecedented potash supply still falls short of the amounts that the agricultural authorities tell us should be used in American agriculture for the most efficient and profitable crop production, particularly at this time of war food demands, it still exceeds the amounts previously purchased by the American farmer; however the long-standing and consistent parallelism between the farmer's income and what he spends for plant food leaves little doubt that he is prepared to buy this increased supply of potash with his currently unequalled income of \$20,000,000, especially so now that other competing commodities are in limited supply.

For years past the fertilizer industry has made progress in teaching the farmer to put more emphasis on the plant-food content and less on the price per ton of the fertilizer mixtures purchased, efforts now to bear fruit during this period of farm prosperity and limited output of mixed goods tonnage due to the restricted labor supply in fertilizer plants with little prospect of substantial improvement.

Surely the farmer under pressure from all sides to make the most of his facilities, also limited, to obtain his maximum output needs little persuasion to apply his abundant funds to the purchase of quality instead of bulk. With the large supplies in prospect of all three major plant foods, nitrogen, phosphate and potash, and with limitations imposed on the number of tons into which they can be mixed, the farmer's only chance of procuring his share of this abundance is through the use of the high analysis mixtures. Only by so doing can our war food efforts attain their maximum success.

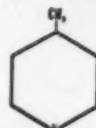
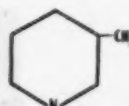
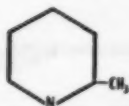
J. W. Turrentine, president, American Potash Institute, before Division of Fertilizer Chemistry, American Chemical Society, New York, Sept. 11, 1944.

IMPROVEMENTS IN ACID-RESISTING SILICON IRON ALLOYS

VALUABLE corrosion resisting properties of the silicon iron alloys containing upwards of 14 percent silicon are well known in the chemical industry. Since their discovery some thirty years ago and their application in the construction of chemical plant the experience of chemists and engineers has shown that in spite of their excellent corrosion resistance these alloys which are used in the form of castings, are subject in their use to certain restrictions and limitations. These limitations arise from (a) a tendency to unsoundness, (b) a tendency to crack and (c) a certain degree of hardness and brittleness.

The first two of the limitations of castings in silicon iron are of major importance in that they govern the reliability of such castings in service. The importance of re-

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DISTILLATION RANGE	It shall have a distillation range from the very first drop to dry point not exceeding 2.0° C., including the temperature of 129.3° C.	95% shall distill within a range of 2.0° C., including the temperature of 144.2° C.	95% shall distill within a range of 2° C., including the temperature of 145.4° C.
SOLUBILITY	Very soluble in water. Soluble in most common organic solvents including alcohols, esters, ethers, ketones, aliphatic and aromatic hydrocarbons.	Very soluble in water. Soluble in most common organic solvents including alcohols, esters, ethers, ketones, aliphatic and aromatic hydrocarbons.	Very soluble in water. Soluble in most common organic solvents including alcohols, esters, ethers, ketones, aliphatic and aromatic hydrocarbons.
USES	Pharmaceuticals, resins, dyestuffs, rubber accelerators, insecticides.	Pharmaceuticals, resins, dyestuffs, rubber accelerators, insecticides, nicotinic acid.	Pharmaceuticals, resins, dyestuffs, rubber accelerators, insecticides.
APPROX. WT. PER GAL.	7.91 lbs.	8.01 lbs.	8.01 lbs.
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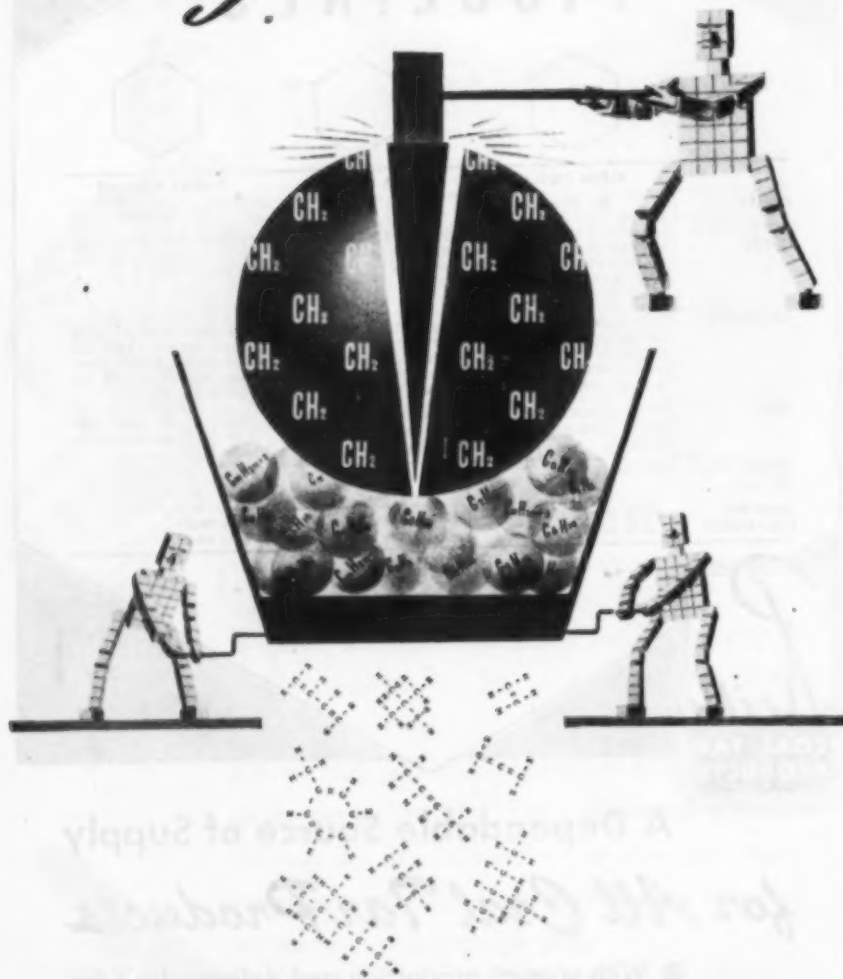
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liability in service arising from the elimination of unsoundness and the avoidance of the risk of cracking can be regarded as the principal motive underlying a large part of the investigations which have been undertaken.

From a metallurgical point of view the important considerations in determining soundness in commercial castings in this alloy are the gas content, particularly hydrogen, the carbon content, and the casting temperature. With a hydrogen content not in excess of 2 ml. per 100 g., a carbon content closely approximating the eutectic value for the particular composition, and a casting temperature between 1,220 to 1,280 deg. C. (disappearing filament pyrometer) conditions of maximum soundness and freedom from hot tears are obtained. For simple general corrosion resistance a silicon content of not less than 14.25 percent is desirable.

The possibility of the existence of internal stresses in silicon iron casting has been demonstrated and also the effect of heat treatment in minimizing the magnitude of, and possibly removing, such stresses. The existence of the unstable carbide phase and the brittle "eta" phase has been encountered and the influence of heat treatment and the careful control of the silicon content in removing risks of internal stresses from these causes has been recognized. The recognition of the presence of internal stresses and their removal or reduction by heat treatment goes a long way towards the avoidance of the risk of cracking in these castings.

Control over the soundness and tendency to crack has resulted in improved reliability in acid resisting silicon iron castings. It would be reasonable to expect that an improvement in soundness and reduction in magnitude of internal stresses would be accompanied by an improvement in strength properties. The published data relating to strength properties are hardly sufficient to enable a quantitative comparison to be made, but it is thought that an average transverse rupture modulus of 18 tons per sq. in. does represent an improvement in ultimate breaking strength.

J. E. Hurst, before joint meeting of the Chemical Engineering Group and the Institution of Chemical Engineers, London, May 23, 1944.

FISCHER-TROPSCH HISTORY

WHILE the extent of American petroleum resources is a controversial subject, there is unanimous agreement that processes for the production of alternative liquid fuels should be investigated and developed in the interests of national defense, both present and future. The Fischer-Tropsch synthesis of petroleum employs gas as a raw material and, consequently, represents a potential new use for gas.

During World War I, Germany had suffered somewhat from a shortage of petroleum. After the Armistice, work was begun to discover methods for producing gasoline and similar products from materials available to the Germans. In 1923 Franz Fischer and Hans Tropsch produced Synthol (synthetisches oel) from water gas at high temperatures and pressures. This product although of value

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ENGINEERING

a chemical raw material was not satisfactory as a motor fuel. Its chief importance to the Germans was that water gas, a mixture of carbon monoxide and hydrogen, could be produced from coal or coke. Thus the production of synthetic fuel was completely independent of petroleum.

Further development of the Fischer-Tropsch process led to the discovery in 1926 of the Kogasin (Kohle-gas-benzine) synthesis at atmospheric pressure and low temperatures. Kogasin is comprised of the following products:

	Percent
Bottled gas (propane, butane, etc.)	8
Gasoline	60
Diesel oil	22
Paraffin wax	10

The Kogasin oil as such cannot be used for motor fuel since it has an octane number of about 20. However, cracking and addition of tetraethyl lead can be used to produce a product of suitable octane number. Since development work on a semi-commercial scale proved successful as early as 1933, many full-scale installations were placed in operation in the period 1933-40. In 1936 the combined German production was 805,000 bbl. of oil per year whereas the yearly capacity was estimated at over 54 million bbl. per year in 1940 or about 10 percent of the total production available to Germany from all sources. The chief advantages of the processes are that the plants are relatively simple in construction, steel requirements are not excessive, low-grade coal may be used, and comparatively small installations may be set up in isolated localities as a protection against bombing.

In addition to the main product, gasoline, a number of other products of value are produced. The diesel oil obtained is of very high quality. From the products of Kogasin, a good grade of lubricating oil can also be produced. Since 1936 the paraffin wax has been employed for the production of synthetic fatty acids, from which soap, cooking fats and artificial butter may be produced.

While the industrial development of the Fischer-Tropsch process has been confined mainly to Germany, the Japanese have been active in development of the process and were producing an estimated 24 to 24 million bbl. of oil per year in 1939. American scientists at the Bureau of Mines were investigating the Fischer-Tropsch process as early as 1928 and, since about the middle of 1943, have again actively pursued the subject. British, French and Russian investigators have also contributed to the development of the process.

Since the start of World War II, two new developments have been announced, "naphthalene synthesis" and "iso-synthesis." The second process is of special importance since it implies that high-octane aviation gasoline can be produced. A deficiency of the process up to the present has been the fact that only straight-chain paraffin hydrocarbons are formed from which high-octane gasoline could be produced only by means of additional processes.

A study of previous work has led to a theory of the mechanism of the reaction. By means of the theory, the choice of catalyst and reaction condition has been narrowed so that it may become possible

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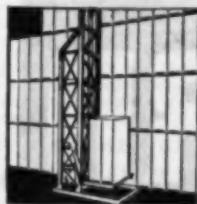
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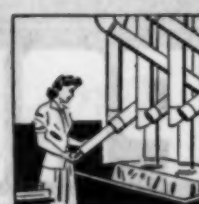
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to direct the reaction toward the production of desired products, e.g., 100-octane aviation gasoline.

The interest of the gas industry in the Fischer-Tropsch process is two-fold. First, both natural gas and manufactured gas may be processed to obtain gas suitable for the synthesis and as such a new use for gas may be developed. Second, the largest demand for gas occurs during the winter months, and therefore, standby water gas plants are idle in manufactured gas plants during the summer months whereas natural gas is sold at lower price to industrial consumers to maintain a uniform load on pipe lines.

Thus, if the present process can be improved in order to reduce production costs or if the reaction can be directed to produce more valuable products, the Fischer-Tropsch process may become economically feasible.

V. I. Komarevsky and C. H. Riess, Institute of Gas Technology, before Division of Gas and Fuel Chemistry, American Chemical Society, New York, Sept. 14, 1944.

PREPARATION OF AMMONIUM NITRATE FOR USE AS FERTILIZER

Solid ammonium nitrate is prepared commercially for use as a fertilizer by concentrating the solution to 95 to 98 percent by (1) Hi-Pan, (2) vacuum, or (3) film evaporation, and granulating the resulting melt by the methods of graining or spraying.

A decrease in the moisture content of ammonium nitrate or a lowering of the temperature results in a greater deposition of crystals and a greater degree of caking than that which takes place for a like change in any other fertilizer material. A gradual increase in moisture content without an accompanying drop in temperature may have an opposite effect. The presence of moisture, however, greatly interferes with the drillability of the material and a subsequent drop in temperature or humidity causes the material to cake to a greater degree than before.

The tendency of granular ammonium nitrate to cake can be greatly reduced by coating the dry material with 0.5 to 1.0 percent of a suitable water-repellent material, followed by 3 to 5 percent of a conditioning agent such as kieselguhr, clay, or tricalcium phosphate, and storing in moisture-proof bags. Ammonium nitrate that has been treated in this way will remain in a drillable condition for prolonged periods in piles at least 12 bags high, providing it is dry when stored and the bags are sufficiently moistureproof to keep it dry throughout the storage period.

Drillability tests under carefully controlled conditions with standard farm equipment indicate (1) that the drillability of any given material increases with the size of its particles; (2) that the sprayed ammonium nitrate now on the market is more drillable than the grained material due to differences in particle size; and (3) that properly conditioned granular ammonium nitrate is as drillable under humid conditions as commercial sodium nitrate.

W. H. Ross, J. R. Adams, Y. T. Yee and C. W. Whittaker, U. S. Department of Agriculture, before Division of Fertilizer Chemistry, American Chemical Society, New York, Sept. 12, 1944.

FOREIGN LITERATURE ABSTRACTS

GLASS ELECTRIC FURNACE

A GLASS furnace has been designed for experimental work which can be used up to about 400 deg. C. Such a furnace is easily made and is very convenient since its contents can be observed at any time during heating. It consists of a tube of Jena glass provided with two ground glass joints. Brass bands are fixed on each end which hold the terminal and the ends of the nichrome winding. A thermocouple may be inserted into a fused-in pocket. A glass mantle supports asbestos rings and serves to reduce external radiation. The sample to be heated is contained in a boat, or may be put in a special little tube. Distribution of temperature throughout the interior of the furnace is uniform.

A furnace 1 m. long and with a diameter of 5 cm., to be operated on a 220-v. supply, should have a winding of 9 m. of nichrome wire with a resistance of 6.3 ohms per m.

For temperatures of up to 600 deg. C., the heating tube should be of Supremax glass and the winding of lower resistance and capable of carrying a correspondingly greater current. The inner tube should be longer than the mantle when working at this higher temperature. This particular design is not suitable for temperatures above 600 deg. C., even if fused silica tubes are employed, since external radiation becomes too great. The furnace tube can be supported on a stand made of wood with asbestos insulating rings. Such furnaces have been used very successfully over long periods and are particularly valuable in view of present materials shortages.

Digest from "Electric Furnaces in Glass" by R. Fricko and F. R. Meyer. *Chem. Z.*, 33, Feb. 1942. (Published in Germany.)

QUININE IN BRAZIL

LIKE MOST tropical and subtropical countries, Brazil is always faced with the problem of fighting malaria. Many efforts have been made to find or produce a substitute for quinine but these have all been unsuccessful for one reason or another. Work in this field and on the development of cinchona and its alkaloids has been supported by the University Research Funds for National Defense of Sao Paulo.

Specimens of Brazilian cinchona bark submitted for analysis have shown four percent total alkaloids and 0.7 percent

quinine. Therefore, although there are quinine-bearing species of cinchona in Brazil, their quinine content is so low and they are so difficultly accessible that it would hardly be worthwhile collecting the bark for commercial purposes. The best answer to this problem would be the cultivation of cinchona trees. Such trees were introduced in Teresopolis 80 years ago and more recently in other regions and were raised very successfully.

Chemical analysis of the barks is extremely important in order that only satisfactory materials may be selected for industrial purposes. The bark of *Cinchona calisaya* var. *Ledgeriana*, for example, which is grown in Java, contains 10 percent total alkaloids and 7 percent quinine.

The federal government of Brazil has a contract with Bolivia for 300 tons of Bolivian cinchona bark annually. While this supply will take care of the immediate needs of Brazil, a crop of trees could be raised which would have a high yield of alkaloid and would supply a good quality, uniform raw material for chemical manufacture of quinine. Such a crop of trees could take care of all Brazil's requirements of this drug. It is important that the other alkaloids contained in the bark, as well as the quinine, have anti-malarial properties, since these alkaloids are found to have just as good anti-malarial effect as quinine without being as toxic.

Digest from "The Problem of Cinchona and its Alkaloids in Brazil," by Richard Wasiecky. *Revista Brasileira de Química* XVII, No. 98, 120-121, 1944. (Published in Brazil.)

SOLUBILITY OF CAFFEINE

IN STUDYING the chemistry of caffeine and the extraction of this material from the coffee bean, it is important to know its solubility in coffee oil. The oil was first extracted from the bean with gasoline and the caffeine removed by means of boiling water. In order to determine whether extraction of the caffeine was complete, a drop of the extract was placed on a glass plate, the water evaporated and the residue examined under a microscope. The absence of any crystals indicates the end of the operation. The oil was then heated on a hot water bath and centrifuged for complete elimination of water. The caffeine was then added to the oil, which was



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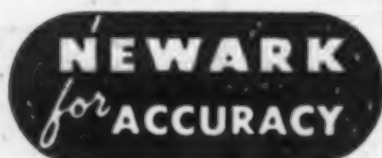
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heated to the desired temperature on a water bath and stirred by means of a mechanical agitator for an hour. The oil was filtered at the same temperature and the nitrogen contained in the filtrate determined by Kjeldahl's method. A check

Solubility of Caffeine in Coffee Oil

Deg. C.	Percent
25	0.41
50	0.91
75	1.18
100	1.18

termination was also made with decaffeinated oil. The factors used for conversion of nitrogen into caffeine were 3.47 and 3.0 respectively for anhydrous caffeine and crystallized caffeine. The attached table shows the solubility of caffeine at the temperatures used in these experiments.

Digest from "Solubility of Caffeine in Coffee Oil" by Lula Ribeiro Guimarães, *Revista de Química Industrial* XIII, No. 143, 26 (1944). (Published in Brazil.)

BABASSU OIL

THE POLIN Laboratories of Rio de Janeiro have made an investigation on the changes that take place in babassu oil specifically the hydrolysis of glycerides and the oxidation of unsaturated fatty acids.

Free acids in the oil, when exposed to air for a period of 33 days, showed an increase of 0.14 percent in oleic acid up to the 11th day, and continued increasing gradually until the 33rd day when the free acid represented by oleic acid, exceeded the initial value by 0.17 percent.

By the 8th day this same oil had a very low peroxide content (0.086 mg. of iodine per gram of oil). By the 33rd day the value was 0.184 mg., double the initial value. The peroxide content therefore increases more progressively than that of the free acid, which shows that the constituents of the oil are more susceptible to oxidation than to hydrolysis. A sample of this same babassu oil after exposure to the action of ultraviolet rays and air showed three times the peroxide content of the original oil.

Digest from "Changes in Babassu Oil" by L. R. Guimarães, *Anais da Associação Química do Brasil*, II, No. 4, 202-5, 1940. (Published in Brazil.)

PLATINUM METALS FOR TECHNICAL USE

CHOICE of a particular platinum metal for technical use depends upon the conditions to be met. The six metals resemble each other, but they also show marked chemical and physical differences. Platinum is characterized by its resistance to oxidation and its ready solubility in aqua regia. Rhodium, iridium, ruthenium and osmium, however, are scarcely attacked by this reagent or only superficially oxidized at the most. Palladium is much more active, being soluble in nitric acid alone.

One of the most important technical properties of platinum is the ease with which it is alloyed with a number of other metals. This property is even more pronounced in palladium, which is the most reactive of the platinum metals chemically. It is dissolved by hydrochloric acid or sodium chloride in the presence of free chlorine. It may be readily obtained in the metallic state by reduction of aqueous solutions of its salts. At red heat palladium is converted to palladium oxide, which de-

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composes at a higher temperature. Hence palladium possesses good thermal stability. An important property is its ability to form an insoluble yellow compound with dimethylglyoxime.

Most important chemical property of rhodium, apart from its insolubility in aqua regia, is the ease with which it forms a stable sulphate. Rhodium can be brought into solution by fusion with potassium bisulphate and thus separated from palladium. An aqueous solution of this sulphate is also the best electrolyte for production of rhodium plating, an important use for this metal. Rhodium has a strong tendency to form intermetallic compounds, such as Bi_2Rh , instead of giving mixed crystals with other metals as do platinum and palladium. This is valuable in the separation of rhodium from the other metals. It is also very resistant to heat. Although it oxidizes above 600 deg. C. the oxide decomposes before it can volatilize.

Iridium may be brought into solution readily only by the use of sodium chloride and chlorine, but its solutions are very resistant to reduction to the metallic state. It is not as stable to oxygen as platinum, palladium and rhodium. Above 700 deg. C. it forms iridium oxide which is volatile below its temperature of decomposition, making this metal unsuitable for use at high temperatures.

Ruthenium and osmium resemble each other closely. They readily form tetroxides, even at room temperature as is the case with osmium. These oxides are very volatile so that alloys containing any appreciable proportion of these metals are of no value for prolonged use at elevated temperatures.

Digest from "Platinum Metals" by K. Ruthardt, *Chem. Tech.*, 117, May, 1942. (Published in Germany.)

BRAZILIAN SALT

Brazil holds a high place among the world's principal producers of sea salt. Its salt works are distributed over 11 states, ranging as high as 123 such establishments in Rio de Janeiro, 204 in Maranhao, and 330 in Sergipe. In addition to its household and other more general uses, salt is an important raw material in the chemical industry. Two of its derivatives, soda ash and caustic soda, are essential in such industries as cellulose, paper, glass and ceramics as well as the manufacture of chemicals such as chlorine, hydrogen and sodium. In addition, the mother liquors from sea salt manufacture are rich in magnesium and potassium and can serve as a source of sodium sulphate, magnesium sulphate, potassium chloride, bromine and metallic magnesium.

Brazil's salt production has been increasing but it is still not sufficient since Brazil consumes approximately 600,000 tons annually. This situation is due to the difficulty of transportation, high cost of freight and lack of proper coordination of the industry. The National Institute of Salt was established in 1940 for the purpose of remedying this situation; the Institute has already done a great deal of corrective work on this problem.

Digest from "Mineral Resources, Brazil, 1942," Bulletin No. 56, 53-55, 1943. (Published in Brazil.)

VERSATILE



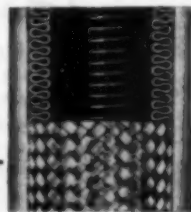
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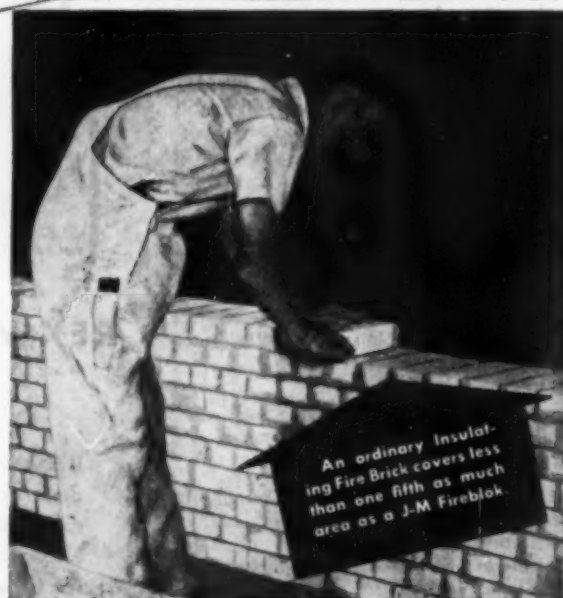
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LESTER B. POPE, Assistant Editor

WORLD PHOSPHATES

PHOSPHATES AND SUPERPHOSPHATES. Second edition. By A. N. Gray. Distributing agents: H. K. Lewis & Co., Ltd., 136 Gower St., W. C. 1, London. 416 pages. Price 21 shillings.

Reviewed by F. S. Lodge

THIS is a greatly expanded second edition of this worthwhile book which first appeared in 1930. The author is secretary of the International Superphosphate Manufacturers Association. He is well qualified to prepare a world-wide treatise on the subjects covered, which include chapters on the world deposits and reserves of phosphate rock and other phosphate minerals, and on their production and consumption in agriculture and commerce. Other chapters cover the methods and practices in the production of normal and concentrated superphosphates, basic slag, calcined phosphate, and other phosphate bearing products used in world agriculture, their cost of production and their utilization and consumption.

It is well illustrated with 38 pictures, mostly of phosphate rock mining methods and machinery for superphosphate manufacture. Many tables and analytical data appear throughout the text and in addition there are 155 statistical tables on phosphate rock and superphosphate world trade. Maps of the phosphate rock deposits of the world are on the inside covers.

This is the most comprehensive work on world phosphates that has been published. The library of every chemist, engineer, and manufacturer dealing with phosphates should contain a copy.

STRUCTURE AND REACTIVITY

THE CHEMISTRY OF CELLULOSE. By Emil Heuser. Published by John Wiley & Sons, New York, N. Y. 1660 pages. Price \$7.50.

Reviewed by M. L. Wolfson

THE LONG-AWAITED revision of Prof. Emil Heuser's textbook of cellulose chemistry (1920: 1924) has at last appeared. The result is now much more than a textbook, it is a compendium and critical digest of the literature of cellulose with emphasis on the scientific rather than on the purely applied aspects. Due consideration has been given to the microscopic and submicroscopic structure of the cellulose fiber. The work forms a coherent and unified treatise. The literature citations are complete and exhaustive. Cellulose publications are prone to be long and detailed so the critical digest and classification of this immense literature by the author is a significant achievement. The general treatment given to the subject by

RECENT BOOKS RECEIVED

Brasil on the March. By M. L. Cooke. McGraw-Hill (Wittlesey House). \$3.

The Chemical Industry. By J. Perry. Longmans, Green. \$1.75.

Coal Tar Fuels. Ed. by J. S. Sach. Assn. of Tar Distillers, London. 35s.

Commercial Methods of Analysis. By F. D. Snell & F. M. Biffen. McGraw-Hill. \$6.

General Chemistry. By J. A. Timm. McGraw-Hill. \$3.75.

Historical Geology. By R. C. Hussey. McGraw-Hill. \$3.50.

Inorganic Chemistry. By F. Eubank, ed. by P. C. L. Thorne & E. R. Roberts. Norde-man. \$8.75.

Metallography and Heat Treatment of Steel. 2nd ed. By E. J. Teichert. McGraw-Hill. \$5.

The Technique of the Terrain. By H. A. Musham. Reinhold. \$3.85.

Uses and Applications of Chemicals and Related Materials. Vol. II. By T. C. Gregory. Reinhold. \$9.

Prof. Heuser has been more from the standpoint of the organic structure and reactivity than from the standpoint of the physics of high polymers. The treatise thus distinctly supplements rather than duplicates the compilation of Ott and collaborators, which likewise is a recent addition to the American literature on cellulose.

RECENT ADVANCES

COLLOID CHEMISTRY, VOL. V. Collected and edited by Jerome Alexander. Published by Reinhold Publishing Corp., New York, N. Y. 1,256 pages. Price \$20.

Reviewed by R. L. Spaulding

This book is a welcome addition to the well-known series on colloid chemistry. Since the first two volumes appeared, nearly two decades have passed and much significant work has been done in developing the theory and method (Vol. 1) and in applying colloid chemistry to the problems of biology and medicine (Vol. 2). This newest volume covers a large part of this work in a series of sixty well written and interesting reviews, each by an outstanding worker in the field. Under the section entitled "Theory and Method," the subjects treated include surface films (W. D. Harkins), electron diffraction (L. H. Germer), x-ray analysis of complex molecular structure (M. L. Huggins), the electron microscope (A. F. Prebus), high-vacuum distillation (K. C. D. Hickman), effects of mechanical stress (P. W. Bridgeman), ultrasonics (K. Sollner), the beta-tron (D. W. Kerst), electrophoresis (D. A. MacInnes and L. G. Longworth), high-speed centrifugation (E. G. Pickels), chromatographic analysis (B. L. Clarke),

and the colloid chemistry of photographic development (S. E. Sheppard). The section entitled "Biology and Medicine" includes discussions of proteins (W. T. Astbury), plant cell membranes (W. K. Farr), nutrition, the gene, gerontology, cancer (Leo Loeb), psychiatry (S. DeWitt Ludlum), and allergy (C. A. Dragstedt), to mention only a few.

A book such as this should provide a convenient means of keeping informed on many of the latest advances in colloid chemistry and as a useful source of information for those engaged in research in medicine, biology or colloid chemistry. It is certainly one of the most important books on colloid chemistry that has appeared for some time and is sure to prove a worth-while addition to many scientific libraries.

THE COMPONENTS OF VARNISH

VARNISH CONSTITUENTS. By H. W. Chatfield. Published by Leonard Hill, Ltd., 17 Stratford Pl., W. 1, London. 496 pages. Price 35 shillings.

Reviewed by Joseph J. Mattiello

This book presents, in a concise and comprehensive manner, the most important varnish constituents as used in the industry today.

It begins with an extended discussion on drying oils, and among the synthetic drying oils it emphasizes the value of dehydrated castor oil in varnishes. However, more information could have been presented on other synthetic drying oils, such as the conjugated linseeds and maleic linseeds, which are also used. This is followed with very useful information on the fatty acids and monoglycerides, which materials are very valuable in the processing of synthetic resins.

The resin portion of the book starts with the natural resins, both modified and non-modified types. The discussion on the latter type of resin is particularly useful at this time. Attention should also be called to the tall oil ester chapter as these esters have taken a significant hold during the war period. Among the synthetic resins presented are included the phenol-formaldehyde and the various modified types, alkyds, urea-formaldehyde, melamine, polystyrene, vinyl, polyvinyl, acetate, polyacrylic, polymethacrylic and chlorinated diphenyls. The paint industry will be especially happy when these resins are available again for normal uses.

It was particularly interesting to note that mixed organic and inorganic resins are presented. These may play a significant part in the industry in the future.

Following the resins, solvents and diluents are presented, covering petroleum, coal tar esters, alcohol esters and ketones,

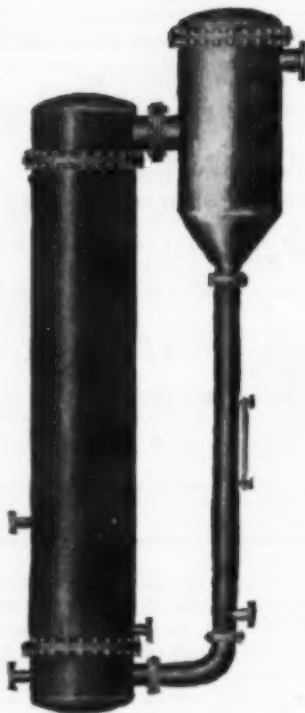
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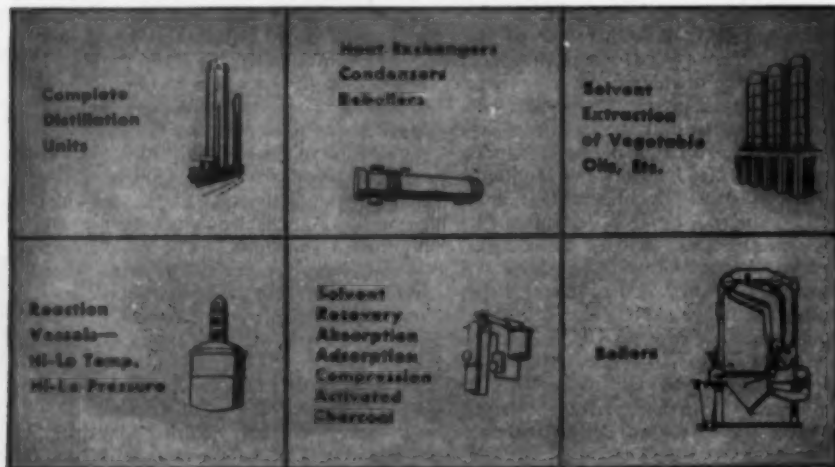
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along with their functions in the coatings.

A whole chapter is devoted to plasticizers. These materials will probably play a larger role in protective coatings than heretofore, but this will not happen until we have correlated the fundamental chemical function of the plasticizers with the other film forming constituents of the varnishes.

Next are discussed the driers and other metallic soaps, anti-oxidants, asphalt and pitches, and waxes. In the future, the waxes may play a more important part in coatings than heretofore.

Finally rubber and chlorinated rubber, as used in protective coatings, are dealt with.

At the end of each chapter, tables of properties of the constituents discussed are included. These tables are very useful.

I agree with the author that the more knowledge a varnish technologist accumulates about the properties of available raw materials and their function in manufacturing varnishes, the easier it will be for a formulator to predict results to be obtained.

This book is presented in a clear, very much to-the-point manner, and the subjects dealt with are valuable at this time. (We have been informed that a photo-offset of this book is available from Interscience Publishers, New York, priced at \$7.—Ed.)

FOR ANALYSTS

THE STANDARDIZATION OF VOLUMETRIC SOLUTIONS. Second edition. By R. B. Bradstreet. Published by Chemical Publishing Co., Brooklyn, N. Y. 151 pages. Price \$3.75.

Reviewed by F. C. Nachod

MR. BRADSTREET'S little booklet contains a lot of useful information for those charged with preparation and standardization of volumetric solutions. It briefly touches the calibration of volumetric equipment, then leads over to indicators and standard substances, and then discusses standardization proceedings. A table of logarithms at the end of the booklet would normally have been helpful; however, the print is so small that it makes for difficult reading.

Your reviewer still frowns upon the use of "molecular weight" for inorganic substances which even in crystalline form are composed of ions and not of molecules. The term "formula weight" is by far preferable and the use of molecular weight seems to be stepping backwards, historically speaking, past the era of Arrhenius.

LABORATORY MANUAL

SOIL AND PLANT ANALYSIS. Published by Interscience Publishers, Inc., New York, N. Y. 368 pages. Price \$4.50.

Reviewed by F. S. Lodge

This book is a monograph from the Waite Agricultural Research Institute of the University of Adelaide, South Australia, of which institution the author is chemist. It is written as a laboratory manual of methods for the examination of soils and the determination of the inorganic constituents of plants with special consideration given to Australian and New

Zealand conditions. The work is divided into two parts: I, Methods for the Examination of Soils, under which are set forth specific, detailed methods for the collection and preparation of soil samples and their mechanical and physical examinations and analysis, as well as complete methods for the determination by chemical analysis of their various constituents; II, Methods for the Determination of the Inorganic Constituents of Plants wherein are given methods for the collection and preparation of plant samples and their ashing in preparation for chemical analysis, including detailed chemical methods of analysis for each of the more common constituents as well as for the trace elements.

Each chapter includes a reference bibliography international in its coverage. The author is very favorably known to soil technologists of this country, as is his institution. This book will be especially valuable to any scientist or technician working with the soil or plant technology of Australia and New Zealand. It no doubt bears the same relation to that type of research in those countries as does the publication "Methods of Analysis," of the Association of Official Agricultural Chemists, to similar work in this country.

PRISM AND GRATING

EXPERIMENTAL SPECTROSCOPY. By Ralph A. Sawyer. Published by Prentice-Hall, New York, N. Y. 323 pages. Price \$5.

Reviewed by Edwin K. Jaycox

This book discusses prism and grating spectrographs and the techniques involved in their application in the fields ranging from the vacuum region of the extreme ultraviolet through the far infrared. The material is presented in a concise but thorough manner starting with the fundamental theories involved and following through to the practical means of application. The book is well planned and is excellent for the student of spectroscopy as well as for the experienced spectroscopist who must service and maintain spectrographic equipment and use it in the many fields in which it is applicable.

Five chapters are devoted to the principles, theory and construction of prism and grating spectrographs. These chapters are of inestimable value to the spectrographer in evaluating his instruments both as to their capabilities and limitations, and to those who contemplate the purchase of spectrographic equipment as an aid in selecting the instrument best adapted to their problems. In these chapters all types of instruments from small hand spectroscopes to the largest prism and grating spectrographs are described. The optical elements including slits, lenses, prisms, gratings, mirrors and the many possible arrangements of these parts are discussed. Methods are given for testing the various optical elements for defects, and for adjusting complete optical trains for highest efficiency. The discussions given are sufficiently complete in most instances, particularly in regard to the fundamentals involved.

Several chapters are devoted to the discussion of the theory and application of accessory spectrographic apparatus, including light sources and instruments for

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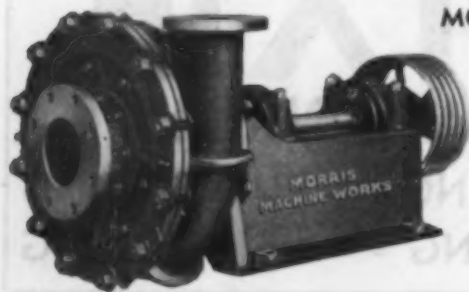
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measuring wavelengths and spectral intensities. Most of the usual means of exciting spectra are dealt with, but in a very general manner. Unlike the chapters regarding spectrographs, details of the construction of excitation circuits are lacking. The expansion of this material would have been of great value to many workers in the field, particularly in regard to the choice of circuit constants for spark and a.c.-arc excitation.

Methods of determining wavelengths are treated in considerable detail. Comparators and measuring microscopes are described and their applications illustrated. The author lists most of the important charts and tables of wavelengths of line and band spectra, and explains their use. Formulas are given for calculating wavelengths for prism and grating instruments.

Subjective and objective methods of determining relative and absolute intensities are presented. The many types of instruments available are discussed and evaluated for the applications for which they are best suited. The author deals with the errors inherent in practically all types of photometers and shows how to correct for them. A section is devoted to "Notes on Photographic-Microphotometric Practice," which is of great value to those engaged in making spectrochemical analyses. Factors important in the determination and the use of characteristic curves are fully covered, from the methods of recording emulsion-calibration marks to the determination of relative intensity. Characteristics of photographic materials receive considerable attention, particularly in regard to their use in photometric work.

Chapters on "Apparatus and Methods of Infrared Spectroscopy," "The Spectroscopy of the Vacuum Ultraviolet," and "Spectrochemical Analysis," are excellent introductions to these subjects. Only the more fundamental aspects are dealt with and their primary value is to the student.

This book will make a valuable addition to the bookshelf of any spectrographic laboratory as a reference and as an aid to those who must test, adjust and maintain spectrographic equipment. It should make an excellent textbook for students of spectroscopy. The author has dwelt more on the fundamental theories of spectroscopy than upon its application. By doing so he has laid a firm foundation from which to embark into the various fields of applied spectroscopy, such as that of the vacuum ultraviolet, infrared and spectrochemical analysis. For those desiring more complete details on much of the subject matter, the author has included extensive references and bibliographies.

ACID THEORY

MORE ACIDS AND BASES. A Collection of Papers by David Davidson; W. F. Luder; W. F. Luder, W. S. McGuire, and Saverio Zuffanti; L. F. Audrieth and Therald Moeller; and Robert Ginell. Published by the Journal of Chemical Education, Easton, Pa. 79 pages. Price \$1.

Reviewed by G. F. Kinney

THE ACID-BASE concept has been the subject of speculation and controversy since the beginning of chemistry. Attempts to

define an acid date to Boyle, to Lavoisier's classical mistake, to Davy, to Arrhenius, and more recently to Brønsted and to Lewis. This little volume, a collection of six papers, indicates an increasing trend to accept the electronic theory of G. N. Lewis that there is no elementary acidifying principle, but that the difference between acid and base is one of electron structure.

Like its predecessor "Acids and Bases" its papers are based on articles in the *Journal of Chemical Education*. Together, the two volumes are an authoritative survey of the relative advantages of the protonic, electronic, and solvent-ion theories of acid-base behavior.

MOTOR CONTROL

CONTROL OF ELECTRIC MOTORS. Second edition. By P. B. Harwood. Published by John Wiley & Sons, Inc., New York. N. Y. 479 pages. Price \$5.

Reviewed by A. E. Knowlton

INCREASED content about control of synchronous motors and about adjustable-voltage controls of d.c. motors has been added to this second edition. Advances in the art during the intervening eight years also are recorded. Another improvement is the discussion of the controls adjoining the treatment of the characteristics of motors to which they are applicable. The chapter on electric excitation and relays has been brought up to date and thus the book is an authoritative and embracing source of information on motor control.

ANNOTATED BIBLIOGRAPHY

BIBLIOGRAPHY OF SOLID ADSORBENTS. Compiled by Victor R. Deitz. Published by U. S. Cane Sugar Refiners Research Project, J. M. Brown, chairman, Revere Sugar Refinery, 333 Medford St., Charlestown, Mass. 877 pages. Price \$12.

Reviewed by F. C. Nachod

THE COMPILATION of Dr. Deitz contains, no doubt, a great deal of useful information and will be of value not only to the sugar chemist but also in some degree to the research worker who deals with adsorption problems.

While emphasis is laid on active carbon, other adsorbents such as silica and alumina and the ion exchangers which have recently come in use for the demineralizing of sugar juices are discussed.

The main subject of this book, aside from a historical introduction (73 pages), consists of over 6,000 literature abstracts. It is regrettable, however, that, while the literature of the field seems to be very adequately covered, no effort was made to include patents in this survey. The patents, admittedly, are very numerous, but without their consideration the compilation seems to be incomplete.

In the effort to give a comprehensive picture, the editor has over-shot his goal and included such topics as properties of graphite or properties of diamond. In doing so, the emphasis which initially was laid on "adsorption" has been thoroughly side-tracked into a carbon bibliography.

A system of cross-references would greatly enhance the value of the book. Also a careful re-editing should precede a second edition, in order to avoid mis-

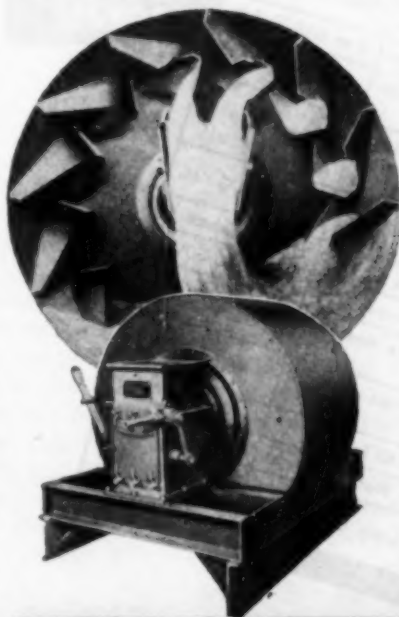
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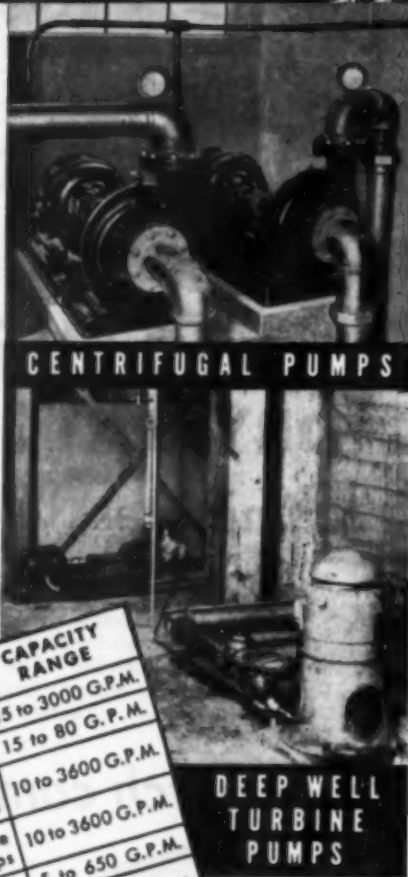
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classification such as abstract 2217 on p. 313 which is wrongly included in section II-5, entitled ionic exchange. A number of abstracts relating to ion exchange (3875, 3889, 3916, 3929, 3949, 3992 to name a few) are only brought under purification of water and sewage and might easily escape a searcher without proper cross-referencing.

The points mentioned above, however, should not deduct from the value of the bibliography which is the result of a tremendous amount of work and which will be very useful for the research workers in many fields.

FERROUS METALLURGY

INTRODUCTION TO FERROUS METALLURGY.

Second edition. 484 pages. Price \$4.

THE MANUFACTURE AND FABRICATION OF STEEL. Second edition. 487 pages.

Price \$4. By Ernest J. Teichert. Published by McGraw-Hill Book Co., New York, N. Y.

THESE two books are part of the Penn State College Mineral Industries Series. "Ferrous Metallurgy, Vol. I" is a textbook for beginners and in it the author devotes 180 pages to fundamental chemistry, physics and electricity, making special reference to their application to metallurgical processes. The remaining chapters introduce the student to pyrometry, fuels, slags, blast furnace operation, iron founding, and the processing of wrought iron and crucible steel.

"Ferrous Metallurgy, Vol. II" is a clearly written and unusually well illustrated volume designed to supplement the everyday experience of the man whose work is in the steel mill. Dr. Teichert surveys modern practice in the operation of the bessemer, open hearth and electric furnaces, and the processing of steel by rolling, forging and casting. There are separate chapters on welding and the manufacture of sheet and strip, wire and tubular products.

TREATISE ON WOOD

WOOD CHEMISTRY. Edited by Louis E.

Wise. Published by Reinhold Publishing Corp., New York, N. Y. 900 pages.

Price \$11.50.

Reviewed by F. C. Nachod

A. C. S. MONOGRAPH No. 97 represents a co-operative effort of 14 experts in the field and renders account of our present-day knowledge of wood chemistry. The book is subdivided into six main parts: The growth, anatomy and physical properties of wood; components and chemistry of the cell wall; the extraneous substances; surface properties of cellulosic materials; the chemical analysis of wood; and last, wood as an industrial raw material. The names of the contributing authors are: Harry P. Brown, Carl C. Forsaith, Richard D. Freeman, William M. Harlow, L. F. Hawley, W. Oury Hisey, Edwin C. Jahn, Ervin F. Kurth, Herman Mark, A. C. Norman, Max Phillips, Alfred J. Stamm, Selman A. Waksman. Special credit goes to Editor Wise who unified the various contributions so that in spite of the multiple authorship, the book is not an incoherent collection of papers but a uniform and highly useful treatise.

The Economic Reconstruction of Europe

THE time is fast approaching when allied and enemy populations alike will demand a blueprint for the economic reconstruction of Europe. The peace plans following this World War will be written piecemeal, and by experts, at a series of continuing conferences, such as Hot Springs, Bretton Woods, Dumbarton Oaks and Quebec, each tracing a new pattern for negotiation and each dealing with a single, specific problem. In the drawing of these plans, the United States, as owner of more than half of the world's industrial capacity, controller of the only great credit reservoir, and possessor of the largest force of highly skilled technicians and management engineers, has heavy responsibilities which its industrial, financial, agricultural and labor leaders cannot evade.

☆ ☆ ☆

Just what is the problem which the world's business leaders must help solve in Europe?

The best safeguard of peace is economic opportunity—a good chance for all peoples to raise their standard of living by their own ingenuity, foresight and industry.

Frustrated and disappointed peoples, who view the future with misgiving rather than hope, breed fanatical demagogues who seek to divert nations from their ills and disappointments by promising military glory and conquests.

Consequently, an important step in building a secure and lasting peace is to open the doors of opportunity to the peoples of Europe.

The greatest obstacle to opportunity in Europe has been economic nationalism.

The economic tradition of the Continent always has been highly nationalistic. The national feeling generated by the first World War, and the political autonomy conferred upon many peoples by the peace treaties, led to a great growth of economic restrictions. This trend was accentuated by the depression and by the military plans of the Fascists and Nazis. Hitler had to show his people they could be fed even if a blockade was imposed again. The inevitable result of these influences was to carry self-sufficiency to tragic extremes.

Economic nationalism holds down the standard of living of Europe in two ways:

1. It prevents the rise in most European countries of low-cost mass production.
2. It operates against an efficient geographical division of labor, preventing nations from doing what each can do best.

Great machines require great markets. One great machine of which the United States has many and Europe few is the continuous strip steel mill. At the outbreak of the war we had twenty-eight such mills of various sizes, England but one, and Continental Europe one. A building containing one of these machines is more than a quarter of a mile long and the minimum cost of the mill is almost \$25,000,000. Only the prospect of a mass market justifies production on this vast, but highly economic basis.

The wasteful geographical distribution of production is shown by the agricultural policies of Italy, France and Germany.

In the 1930's, when lard sold for less than 8¢ a lb. in the United States, it cost 32¢ a lb. in Germany. In Italy and Germany imports of wheat were banned and its production at home was heavily subsidized. By the middle of the 1930's, wheat sold for \$1.55 a bushel in France, \$1.97 in Czechoslovakia, \$2.29 in Germany, and \$2.47 in Italy. At the same time the United States and the other efficient world producers and exporters (Canada, Australia and Argentina) were restricting production and were unable to average more than about 75¢ a bushel for their wheat.

Economic unity in Europe must ultimately mean a freedom to trade not greatly different from what we have within the United States. Given economic unity and the large markets which go with it, efficient mass production will develop. With Europe receiving cheap supplies of such staple foods as wheat, pork, lard and dried fruits from overseas, European farmers can prosper by specializing in producing fresh foods—butter, cheese, eggs, fruits, vegetables.

Then European agriculture will be more prosperous producing its specialties, and our agriculture (and that of the other great efficient surplus-producing countries as well) will have greatly expanded markets for our staples.

With a cheaper food supply for Europe—yet one yielding a better price for our agriculture—European labor will live better. Labor now used uneconomically for agricultural production will be released for industry. With big machines and semi-automatic processes European labor can produce more steel, automobiles, furnaces, plumbing and electrical appliances to advance its standard of living in coming decades, as the United States has done in past decades.

A rising standard of living in Europe will bring

Europeans to view peace with optimism and hope. And world trade grows as confidence and prosperity widen.

★ ★ ★

How would a Europe which possesses economic unity appear to us on this side of the Atlantic?

It would be a prosperous Europe that would have strength in its advancing industries, but as the single great agricultural deficit area of the world, it would be dependent upon overseas supplies for vital agricultural staples. This dependence upon overseas agricultural supplies would be greatest for industrial Germany. Some people believe that a strong Europe would be a threat to world peace. More important, however, is the fact that a strong and prosperous Europe would not be a frustrated Europe. It would have found a way to achieve a rising standard of living. Furthermore, a prosperous Europe would, economically, be a dependent Europe because, although the European industrial worker would use more and cheaper food, he would have it only as long as he maintained the peace.

A prosperous Europe would be of special advantage to American agriculture (if we do not keep on pricing ourselves out of the market) and of great advantage to American industry.

The British policy of buying agricultural staples from abroad, for example, made her, a nation of only 45,000,000, the purchaser, in 1937, of \$250,000,000 of all kinds of agricultural products from the United States. In the same year the rest of Europe (exclusive of Russia), with a population of 325,000,000 purchased only \$300,000,000 of our agricultural products. But with more sensible organization of its agriculture, Europe could be expected to buy more than one billion dollars of agricultural products from us.

By far the greatest market for an expanded European industry will be Europe itself.

For American industry, there will be growing markets in Europe as industry expands. Experience shows that the trade between different highly industrialized areas is large. This country's biggest export markets have been with its keenest competitors—Britain, Canada, Japan, France and Germany.

Before the war, Europe, with two and one-half times the population of the United States, had only one-sixth as many automobiles.

If Europe (exclusive of Britain and Russia) were to motorize proportionately, it would need 75,000,000 automobiles. With normal depreciation this would ultimately mean 10,000,000 cars to be produced annually to replace worn out cars.

If one still wonders about the immense number of things Europe might produce *for herself*, let him calculate the highway expenditures, the filling and repair station businesses that must be equipped and maintained; and the doubling of the steel production that would be required to make the automobiles themselves and to reinforce with steel even a moderate amount of additional concrete highways.

Another example is the electrification of Europe. With two and one-half times our population Europe's

consumption of electrical energy would be 175 million electrical H.P., if the European worker were to have the advantage of as many H.P. as the American. Yet, just prior to the war, Europe's installed operating capacity was only about 40 per cent of this figure.

★ ★ ★

What has been sketched for Europe is actually much more nearly a page from the economic history of the United States than it is mere prophecy about a desirable future for a Europe at peace. But how can it be achieved? And what is our part to be in helping to bring it about?

Economic unity can be provided for the sovereign states of Western Europe by the peace treaty provisions adopted at the end of the war. The provisions for securing economic unity in Europe should specifically cover:

1. Substantial freedom for persons and enterprises to do business anywhere in Europe.
2. Reasonably free movement throughout Europe of persons for employment, recreation and education.
3. Greatly increased freedom of trade:
 - a. Within Europe—through the application of a Europe-wide agreement reducing the tariffs among all European countries to a maximum of 10 or 15 per cent.
 - b. With the rest of the world—through reduction of European tariffs on goods bought from overseas. This would call for generally lower levels on manufactured goods, and for the removal (after a reasonable period of progressive reduction) of tariffs on all agricultural foodstuffs and most industrial raw materials.
4. A special currency provision requiring as nearly as practicable complete currency stabilization for all countries of Western Europe among each other.
5. Creation of an agency (with adequate revenues) through which all Europe-wide business and other affairs affected by these agreements would be administered for a minimum period of twenty-five years.

This would permit the economic unity of Europe to be substantially achieved. During this period assistance in administering the provisions would be given by officials of the United Nations.

Near the end of such a period arrangements could be made for a vote in the European countries as to whether or not to continue the "unification provisions." If the vote were in the negative, the United Nations would have proper warning that additional safeguards would be necessary to prevent war.

The suggestions made in this statement aim at securing economic unification of Europe and thereby promoting the possibilities of permanent peace in Europe.

The realization of these possibilities throughout the postwar years requires a freely expressed public opinion in Europe to guide all who share the responsibility for bringing peace to Europe and to the world.

James H. McGraw, Jr.

President McGraw-Hill Publishing Company, Inc.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publications noted in this list always give the complete title and the issuing office. Remittances should be made by postal money order, coupons, or check. Do not send postage stamps. All publications are in paper covers unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the Bureau responsible for its issue.

The Synthetic Rubber Program, Plant Investment and Production Costs. By Bradley Dewey, Rubber Director. Special Report of Office of Rubber Director. War Production Board.

Rayon Versus Cotton Cord for Tires. Part 21 of Investigation of the National Defense Program. Hearings before a Special Committee Investigating the National Defense Program, U. S. Senate, 78th Congress, 1st and 2d Sessions. Pursuant to S. Res. 6. Price \$1.

Minimum-Wage Budgets for Women. Bureau of Human Nutrition and Home Economics. Miscellaneous Publication 549M. Price 10 cents.

Principles of Nutrition and Nutritive Value of Food. By Henry C. Sherman. Department of Agriculture Miscellaneous Publication No. 546. Price 10 cents.

List of Antioxidants Proposed for the Preservation of Edible Fats (with a Selected Bibliography of Papers and Patents). Bureau of Agricultural and Industrial Chemistry. AIC-54. Mimeographed.

Preparation and Use of Dusts, Sprays, Washes, and Dips Containing Rotenone for the Destruction of Cattle Grubs. Bureau of Entomology and Plant Quarantine. E-623. Mimeographed.

Preliminary Tests of Synthetic Organic Compounds as Insecticides. Part I. By M. C. Swingle, A. M. Phillips, and J. B. Gahan. Bureau of Entomology and Plant Quarantine. E-621. Mimeographed.

Dehydrated Vegetables. Tariff Commission

Report No. 5 of War Changes in Industry Series. A statistical summary of production and use during the war.

Mineral Wool: Blankets, Blocks, Insulating Cement, and Pipe Insulation for Heated Industrial Equipment. Bureau of Standards Commercial Standard CS117-44. Price 10 cents.

Antiscatter Treatments of Glass. By Frank W. Reinhart, Ruth A. Kronstadt, and Gordon M. Kline. Bureau of Standards Miscellaneous Publication M 175. Price 10 cents.

Animal and Vegetable Fats and Oils. Prepared under the supervision of Zellmer R. Pettet. Bureau of the Census. Price 10 cents. Production, Consumption, and Stocks, Quarterly for Calendar Years 1939 to 1943, Inclusive; and Imports and Exports for Calendar Years 1939 through 1940, and the First Three Quarters of 1941.

Barographs. War Department Technical Manual TM 11-425. Price 10 cents.

Distilling Apparatus. War Department Technical Manual TM 8-612. Price 10 cents.

Power Units. War Department Technical Manual TM 11-915. Price 25 cents.

Sanitation. Navy Department, Bureau of Ships. Bureau of Ships Manual, Chapter 36. Price 5 cents.

Instructions for the Operation, Care, and Repair of Compressed Air Plants. Navy Department, Bureau of Ships. Bureau of Ships Manual, Chapter 49. Price 10 cents.

Canal Project Areas. Department of State, Executive Agreement Series 388. Price 5

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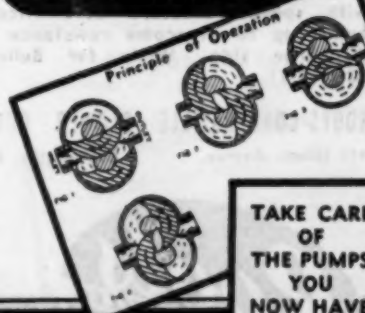
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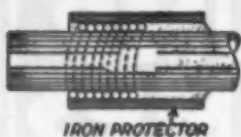
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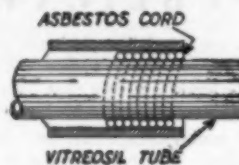


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Establishment of the Inter-American Cooperative Food Production Service in Peru. Department of State, Executive Agreement Series 385. Price 5 cents. Agreement between the U. S. and Peru.

Canol Project Exploratory Wells. Department of State, Executive Agreement Series 388. Price 5 cents. Agreement between the U. S. and Canada.

Wheat. Department of State, Executive Agreement Series 384. Price 10 cents. Memorandum of Agreement between the U. S., Argentina, Australia, Canada and the United Kingdom.

Production of Industrial Explosives in the U. S. During the Calendar Year 1943. Bureau of Mines Technical Paper 665. Price 10 cents.

Rare and Uncommon Chemical Elements. Coal. Bureau of Mines Technical Paper 661. Price 10 cents.

Analyses of Kentucky Coals. Bureau of Mines Technical Paper 652. Price 40 cents.

Accident-Record Manual for Industrial Plants. Prepared by Division of Industrial Hazards, Max D. Kossoris, Chief. Bureau of Labor Statistics Bulletin No. 772. Price 10 cents.

Union Agreements in the Leather-Tanning Industry 1943. Prepared by the Industrial Relations Division, Florence Peterson, Chief. Bureau of Labor Statistics Bulletin No. 771. Price 10 cents.

Congressional Directory, 78th Congress, 2nd Session, June 1944. Price \$1.25 (cloth bound).

Renegotiation Regulations for Fiscal Year Ending After June 30, 1943. War Contract Price Adjustment Board. The above publication and 12 monthly supplements is sold on a subscription basis. Price \$2. Issued in loose-leaf form.

Federal Specifications. New or revised specifications which make up Federal Standard Stock Catalog have been issued on the following items: Potassium Bromide, (for) Photography: O-P-551. Potassium Iodide, (for) Photography: O-P-558. Lamps, Electric, Incandescent, Miniature, Tungsten-Filament: W-L-11b (1943 Supplement). Salt, Table: SS-S-31b. Solder, Silver: QQ-S-54b. Price 5 cents each.

RECENT BOOKS

& PAMPHLETS

Seamless Steel Tube Data. Published by Seamless Steel Tube Institute, Pittsburgh, Pa. 320 pages. Price \$2.50. Reference book in four sections: general data, mechanical tubing, pressure tubing and references tables. General history, manufacture, tests, special shapes, compositions, mill practices, proper sizes, specifications, tolerances, etc. Tabular presentation of data is used extensively.

The Storage of 1:3 Butadiene. Research Bulletin No. 7,381-C, second edition, published by Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa. 36 pages. Physical and chemical properties, container materials, protective coatings and proper storage conditions.

Geologia do Brasil. Second edition. By A. I. de Oliveira and O. H. Leonardos. Published by Servico de Informacao Agricola, Ministerio da Agricultura, Rio de Janeiro, Brazil. 611 pages. A very complete geology of the country. (Written in Portuguese.)

Export Market Opportunities for U. S. Manufacturers. Published by Alcoa Steamship Co., New York 4, N. Y. 20 pages. Data of the markets in the close-at-hand Caribbean, Venezuela, and in the Guianas.

Manganiferous Iron-Ore Deposits Near Silver City, New Mexico. By L. P. Entwistle. Bulletin No. 19, New Mexico School of Mines, Socorro, N. M. 72 pages. Price 30 cents.

Bibliography of References to the Literature on the Minor Elements and their Relation to Plant and Animal Nutrition. Compiled by L. D. Willis. Published by Chilean Nitrate Educational Bureau, 120 Broadway, New York, N. Y. 96 pages. Fifth supplement to the third edition; contains 722 abstracts which include 117 crops and 40 elements.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Adhesive Data. Minnesota Mining & Mfg. Co., 900 Fauquier Ave., St. Paul 6, Minn.—8-page booklet giving uses and special data tables for color, bonding range, viscosity, special features and net weight of 3-M adhesives.

Alloy. Cerium Metals Corp., 522 Fifth Avenue, New York 18, N. Y.—6-page folder describing composition, range, applications of cerium master alloys for industrial uses.

Annual Report. American Car & Foundry Co., 117 Main St., Flemington, N. J.—52-page 45th annual report of this concern, together with a consolidated balance sheet of the company and wholly-owned subsidiaries for the fiscal year ended April 30, 1944. Also a pictorial record of the work going on in various plants and some illustrations of the uses to which the products are put.

Barometric Condensers. Acme Copper-smithing & Machine Co., Orelan, Pa.—4-page folder describing operation, installation and sizes of multi-jet barometric condensers, and including detailed sketches. Bulletin MJ-44; also 1-page leaflet discussing counter-current barometric condensers and steam jet ejectors.

Boiler Ratio Meter. Cochran Corp., 17th St. at Allegheny Ave., Philadelphia 32, Pa.—Booklet describing methods of checking combustion efficiency in boiler plants, setting forth the requirements for an ideal boiler meter and describing the Cochran Boiler Ratio Meter, said to meet the stipulations.

Casters. Faultless Caster Corp., Evansville, Ind.—4-page bulletin illustrating casters for industrial use and giving specification tables for many types. Bulletin No. 155B.

Conveyor Systems. Morse Boulder Distributor Co., New York 17, N. Y.—4-page

bulletin describing an air-activated conveyor system giving information on types of materials which can be handled, costs and special features. Includes list of installations and arrangement sketch. Bulletin No. 310.

Dampers. Thermix Engineering Co., Greenwich, Conn.—Illustrated catalog containing data on damper problems and featuring the Heacon "Controlled Flow" Damper. Gives case histories and diagrams showing increased efficiency gained by a variety of applications. Discusses binding, warped shafts, dynamic balance, power requirements and simplified maintenance of damper installations.

Direct Current Motors. Century Electric Co., 1806 Pine St., St. Louis, Mo.—4-page dimension sheet, supplying detailed information on sleeve and ball-bearing open-rated motors, and on ball-bearing, splash-proof motors in horsepower sizes. Nos. 10-315, 10-317.

Dryers. Proctor & Schwartz, Inc., Seventh St. and Tabor Rd., Philadelphia 20, Pa.—4-page folder describing tray and truck dryers, sketching applications and including features and a table of specifications. Bulletin No. 300.

Electrolytic Conductivity. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.—44-page catalog describing instruments for making precise conductivity measurements in plant, laboratory and classroom. Also discusses combinations of equipment and includes illustrated catalog listing, and check-list of other literature describing standard equipment. Catalog EN-95.

Elevators. West Bend Equipment Corp., West Bend, Wis.—18-page pamphlet dealing with portable hand-operated and electric elevators, giving specifications, features, and installation information. Illustrated. Bulletin No. 540-R.



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Fire Protection. Press Bureau, Randolph Laboratories, Inc., 8 East Kinzie St., Chicago 11, Ill.—16-page booklet describing techniques of fire-fighting with CO₂, its characteristics, and arrangement and distribution of fire extinguishers and plant fire-fighting systems. Bulletin No. R-5827.

Furnaces. Hevi Duty Electric Co., Milwaukee, Wis.—2-page leaflet describing a convection tempering furnace for temperatures up to 1,300 deg. F., giving uses, construction, power, specifications. Bulletin No. HD 744.

Furnaces. Hevi Duty Electric Co., Milwaukee, Wis.—4-page booklet giving uses, design data, construction features and information on specific requirements and heating elements of electric furnaces. Illustrated. Bulletin No. HD-644.

Furnaces. Surface Combustion, 2375 Dorr St., Toledo 1, Ohio—4-page leaflet describing surface combustion furnaces in the steel wire industry, giving uses, installation data and sizes. Form No. SC-117.

Gas Chemistry. Surface Combustion, 2375 Dorr St., Toledo 1, Ohio—4-page pamphlet dealing with applied gas chemistry of prepared atmospheres in surface combustion furnaces, giving composition data, different applications and a table of composition, reaction and applications of various prepared atmospheres. Form No. SC-118.

Industrial Rubber Footwear. The B. F. Goodrich Co., Akron, Ohio—4-page folder presenting this company's line of industrial footwear made with GR-S synthetic rubber. Pictures different products and gives information on ration certification involved. Catalog Section 12040.

Materials Handling. Albert H. Cayne, 264 Canal St., New York 13, N. Y.—6-page booklet describing materials handling equipment of various concerns. Includes illustrations.

Meter. Builders-Providence, Inc., Providence 1, R. I.—4-page pamphlet describing design, applications, installation, features, and size of a Propello meter. Includes sketch, cutaway drawing and materials of construction information. Bulletin No. 350.

Mobile Power Plants. American Car & Foundry Co., 117 Main St., Flemington, N. J.—12-page folder describing the development, types and specifications of 1,000-kw. mobile steam power plants. Includes illustrations and color sketch.

Moisture Meter. C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn 5, N. Y.—4-page bulletin describing a dielectric moisture meter, supplemented with a diagram and operation data, and specifications. Bulletin No. 1263.

Paper Bag Closures. Union Special Machine Co., 400 North Franklin St., Chicago, Ill.—8-page bulletin describing a tape closure produced on small paper bags. Gives installation information, users' reports and data on formation, production and uses. Bulletin No. 100.

Plastics Stock Molds. Plastics Stock Molds, 121 East 41st St., New York 17, N. Y.—182-page, plastic-bound booklet presenting data on 1,600 stock molds, 200 standardized extruded cross-sections and standard laminated sheets, rods and tubes. Includes 22 classifications and 6 indexes. Price \$5.

Pipe Lines. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago 12, Ill.—Booklet entitled "Big and Little Inch," devoted to electrical features of the 24- and 20-in. pipe lines. Includes views and line diagram.

Pipes. Dresser Mfg. Co., Bradford, Pa.—4-page folder giving installation data, advantages, speed, and characteristics of the Bellmaster mechanical joint. Includes cutaway sketch and tables of deflection, and sizes and specifications. Bulletin No. 441A.

Pressure Maintenance. Clark Bros., Inc., Olean, N. Y.—16-page bulletin containing an article called "A Method for Evaluating Pressure Maintenance." Includes illustrations and graphs. Technical Publication No. 1665.

Pressure Vessels and Fabricated Steel. Union Iron Works, Erie, Pa.—3-page leaflet presenting this concern's line of high pressure steel boilers and pressure vessels, with their advantages and construction methods. Booklet 117.

Pumps. Worthington Pump & Machinery Co., Harrison, N. J.—8-page booklet No. W-341-B8A, describing capacities, heads, speeds and dimensions of Types DHL and DHBL two-stage mono-bloc centrifugal pumps; 8-page bulletin, No. W-341-B2B, presenting illustrated data on design and dimensions of Types HR

and HB one and two-stage volute centrifugal pumps for refinery service; 12-page bulletin, No. W-324-B2, dealing with regenerative turbine pumps, including rating tables; 6-page illustrated folder, No. W-414-B40, with specifications and dimensions of Type VTE power pump.

Pulleys. The American Pulley Co., 4200 Wissahickon Ave., Philadelphia 29, Pa.—8-page catalog describing high-torque motor pulleys, giving advantages, construction, list prices, for standard and made-to-order pulleys and design data. Bulletin No. HT-44.

Pumps. Blackmer Pump Co., Grand Rapids 9, Mich.—8-page folder describing a line of pumps for the petroleum industry, featuring design and operating information, capacity figures for bulk-station, rotary-hand, and truck pumps, together with specifications and dimensional tables. Includes some typical installations. Bulletin No. 102.

Rectifiers. Fansteel Metallurgical Corp., Rectifier Division, North Chicago, Ill.—12-page pamphlet containing technical data, specifications, illustrations, wiring diagrams, catalog listings and ordering references on more than 130 standard selenium rectifiers. Bulletin No. RDP-105.

Plasticisers and Resins. Hercules Powder Co., Wilmington 99, Del.—8-page booklet describing the properties of Clorafin 42, a plasticizer and Clorafin 70, a resin used in the production of fireproof, waterproof and weather-proof coatings for fabrics. Includes graphs and tables tabulating specific properties, reactions and analyses, and gives uses. Bulletin No. 500-21.

Pneumatic Materials Handling. The Allen-Sherman-Hoff Co., 225 South 15th St., Philadelphia 2, Pa.—4-page folder discussing facts about pneumatic handling of materials, describing the various steps in the process, listing necessary apparatus, and operating conditions. Bulletin No. 744.

Presses. Watson-Stillman Co., Roselle, N. J.—4-page bulletin describing a general utility vertical-horizontal press, giving convertibility features, operation information and capacities. Bulletin No. 330-A.

Presses. Watson-Stillman Co., Roselle, N. J.—4-page leaflet covering extrusion, cold-molding and preform presses, telling uses, and including technical data tables dealing with capacities, sizes and speeds. Bulletin No. 650-A.

Pressure Filters. Oliver United Filters Inc., 33 West 42nd St., New York 18, N. Y.—4-page bulletin describing the construction details, operation, pressures and sizes of a standard pressure filter. Includes table of general data and illustrations. Bulletin No. 111-R.

Pressure Piping. Johns-Manville Corp., 22 East 40th St., New York, N. Y.—110-page brochure dealing with Transite pressure pipe for the pulp and paper industry, giving technical data in regard to operation, installation, assembly, dimensions of many types of pipes and couplings. Profusely illustrated. DS Series 355.

Pre-Testing Equipment. Kold-Hold Mfg. Co., 400 Grand Ave., Lansing, Mich.—Bulletin describing a line of "altitude" test chambers in which a manufacturer can see the potential reaction of his products at any given altitude, temperature and percentage humidity.

Process Equipment. B. F. Goodrich Co., Akron, Ohio—12-page illustrated catalog, entitled "The Process of Extruding," giving comprehensive data for industrial engineers and designers about extrusion and the products that can be made from natural, synthetic and reclaimed rubber and from plastics. Details the operation and includes a list of users of extruded parts.

Refrigeration and Air Conditioning. York Corp., York, Pa.—Looseleaf booklet designed to give "finger tip" information on: accessories and supplies, ice cans and air fittings, oil, cold storage doors, renewal parts, tables and data. Latter include sizes, weights, performance data, net prices, drawings.

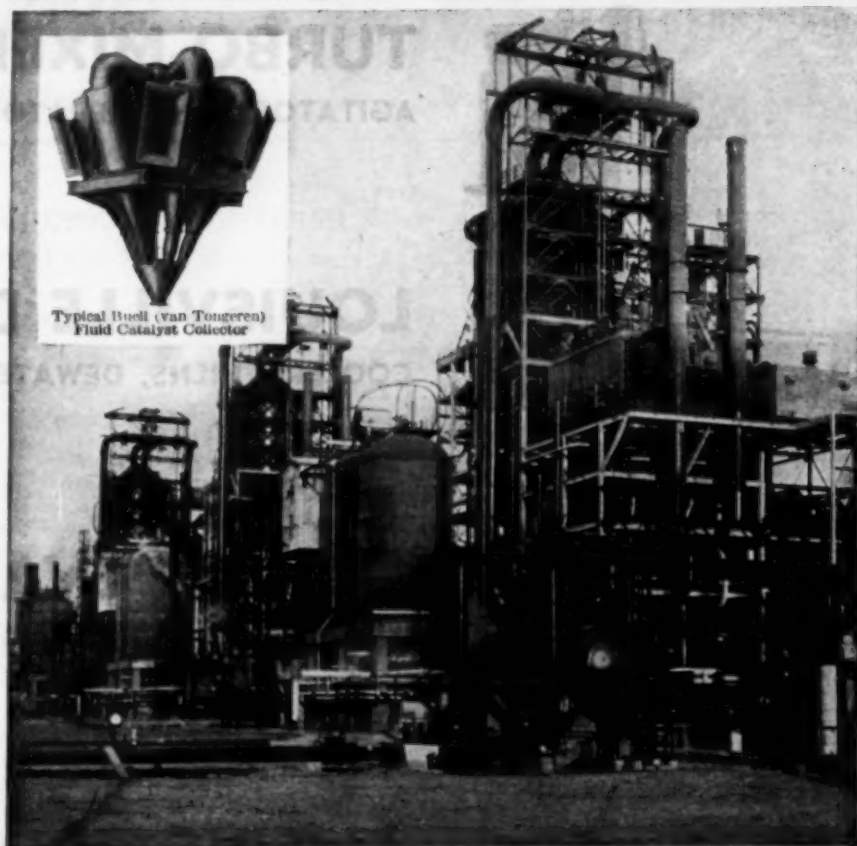
Resins and Plastics. Chemical Division, B. F. Goodrich Co., Akron, Ohio—4-page bulletin describing vinyl chloride polymers and copolymers, in resin as well as plastic form. Includes data on fillers and pigments, plasticizer and stabilizer tables, and lists typical formulations. Technical Bulletin No. PM².

Welding. Tube Turns, Inc., Louisville, Ky.—Pocket-size dimensional data chart giving quick layout information on welding fittings and flanges. 9x24 in. charts may be spread out on table or folded to fit pocket.

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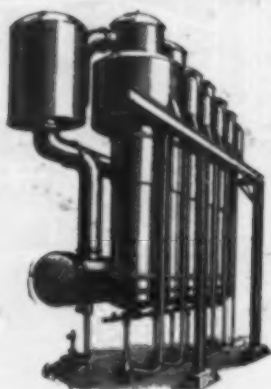
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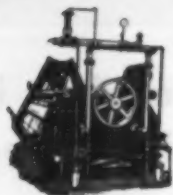
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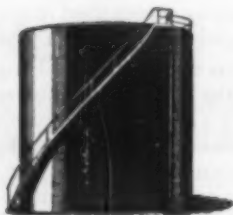
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CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

INDUSTRIAL CONSUMPTION OF CHEMICALS REGISTERED MODERATE GAIN IN LAST TWO MONTHS

WHILE SOME of the large consuming industries, such as iron and steel and petroleum refining, operated at an unchanged rate throughout August, the trend in general was along an upward curve and total consumption of chemicals in industry registered a fair recovery from the low point reached in July. The overall figure is considerably affected by developments in the highly weighted fertilizer industry. Originally a very high goal had been set for superphosphate production but this has been found difficult of attainment because the supply of sulphuric acid has not come up to expectations because of the change in production schedules at munition plants and the practical elimination of spent acid for fertilizer use. This situation may not improve for some time but in the more distant future new sources for acid should serve as a guarantee against any shortage. In the meantime, superphosphate output has fallen sharply from the peak levels of production.

Furthermore, the fertilizer trade has been notified that the situation surrounding chemical nitrogen has grown worse since June. The shutting off of ammonium compounds except sulphate has turned attention to other nitrogen-bearing materials and arrangements have been made to increase imports of nitrate of soda and 500,000 tons have been given a preferential shipping rating with 350,000 tons additional to be brought in if tonnage is available. The potash outlook also was said to be less favorable, especially as concerns sulphate. During the first half of this year shipments of potash increased by about one-seventh over those for the corresponding period of last year and producers expect to supply all requirements through the peak season of use in 1945 with the prospect that export requirements will be decreased.

Pulp and paper mills have been favored with a larger supply of pulpwood with August receipts at about 12 percent higher than they were in August last year. While encouraging, this does not mean that future receipts will hold up to the necessary levels and the industry apparently will have to hold production schedules in check until such time as the pulpwood problem draws nearer solution.

Operations at textile mills were on a broader scale in August and appear to be holding up since then but labor shortages are still a detriment to full-scale production and recent reports state that carpet mills in some areas are beginning to feel to draining of workers by other industries which are in a higher wage classification.

The offer made by the government to purchase cotton at parity also is regarded as a threat to manufacture of textiles as textile ceilings have been only partially adjusted to compensate for full parity prices for cotton.

The Chem. & Met. index for industrial consumption of chemicals climbed back to 183.84 in August as compared with a revised figure of 176.63 for July. Last year the index for August was 181.94 and for July it was 172.42. A year ago fertilizer manufacture was moving up at a rapid rate and it is this reversal in that industry which has brought the index to the level of the corresponding time last year and present indications are that over the remainder of this year the number will closely approximate the average recorded for the final quarter of 1943. This will tend to lower the rate of increase which was scored for this year in the first seven months of the year.

Incidentally, sulphuric acid has received much attention recently due to the

Chem. & Met. Index for Industrial Consumption of Chemicals

	July	Aug.
	Revised	
Fertilizers	36.00	38.55
Pulp and paper	18.70	19.45
Petroleum refining	18.70	18.68
Glass	19.70	20.75
Paint and varnish	16.80	16.50
Iron and steel	13.40	13.46
Rayon	15.75	16.73
Textiles	9.60	10.99
Coal products	10.20	10.30
Leather	4.00	4.30
Industrial explosives	5.49	5.83
Rubber	3.00	3.00
Plastics	5.20	5.30
	176.63	183.84

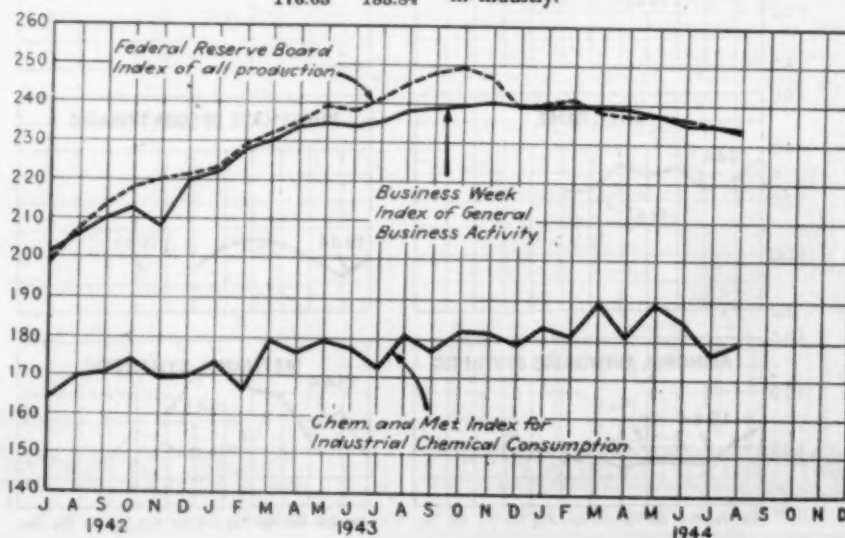
announcement that the revised ordnance program, calling for a rise in outputs of heavy explosives, would require large amounts of acid. In order to meet the amount of acid needed for all purposes, it is found that production must be extended. New plant capacities had been provided for in earlier action but it is now found that further additions will be necessary.

A representative of the Chemicals Bureau of WPB has stated that our acid capacity in 1943 was 8,393,100 tons of 100 percent and by next June capacity is expected to reach 9,426,600 tons. Demands for new and spent acid during the present year are expected to reach 10,556,200 tons while the estimated supply will total only 9,650,700 tons. Requirements for the first half of next year are estimated at 5,663,600 tons of acid with only 5,251,000 tons as the probable supply to meet this demand. In short, there will not be enough acid to fill all demands unless provisions are made for further new plant capacities.

A breakdown of acid requirements for all of 1944 and for the first six months of 1945 shows the following:

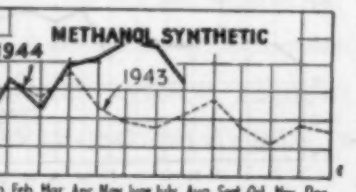
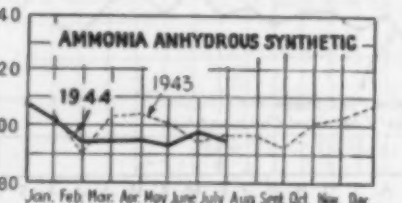
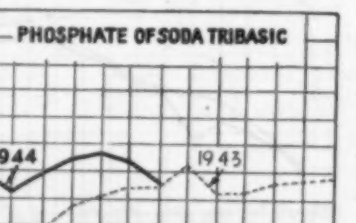
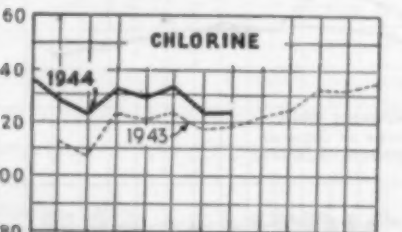
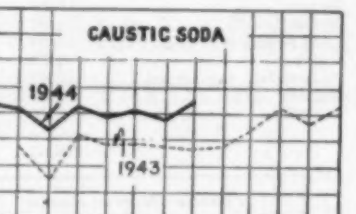
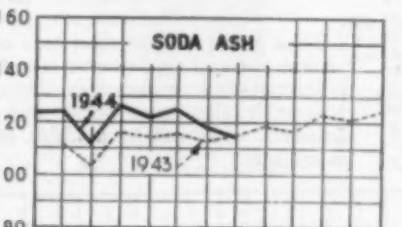
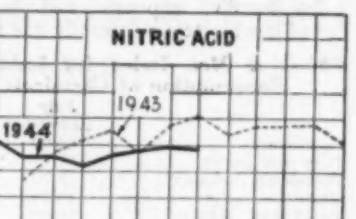
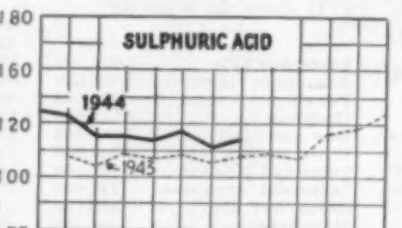
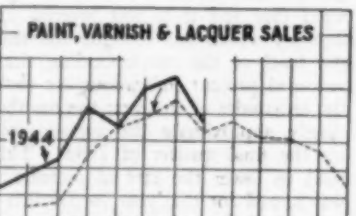
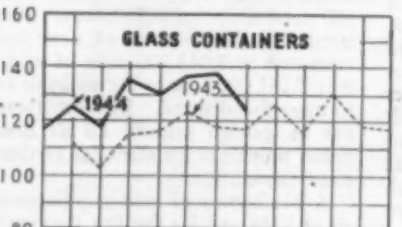
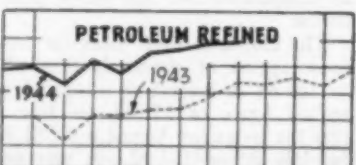
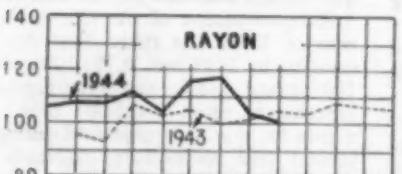
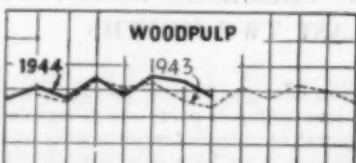
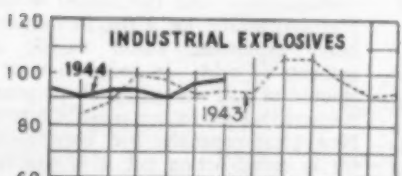
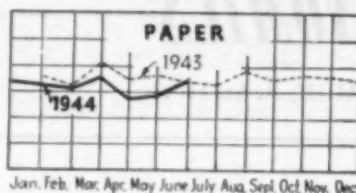
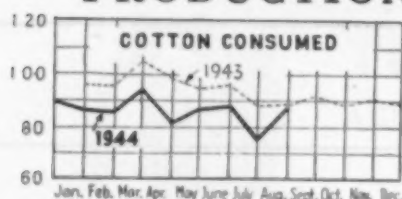
	1944	1945
Superphosphate	2,852,900	1,558,000
Ammonium sulphate	694,500	861,200
Petroleum refining	1,477,000	890,900
Chemicals	2,188,600	1,130,000
Iron and steel	558,400	291,700
Other metallurgical	348,000	174,500
Paint and pigments	767,100	389,600
Industrial explosives	742,600	375,400
Rayon and film	528,100	289,300
Miscellaneous	404,000	202,400
	10,556,200	5,663,600

These totals refer to short tons of 100 percent acid and are exclusive of ordnance production and requirements although it is possible that some spent acid from ordnance works will be available for use in industry.



PRODUCTION AND CONSUMPTION TRENDS

100 = Monthly Average for 1942



FROM ACTUAL production data for the first seven months of this year, the progress made by a fair cross section of chemical manufacture may be obtained. In the first place the figures show that production schedules are not uniform throughout the industry as some chemicals have been turned out at a high percentage of increase over last year, others at a lower percentage rise and some failing to meet the volume turnouts of last year. For such basic chemicals as sulphuric acid and soda ash, the increase in production over the corresponding period of 1943 is between 7 and 8 percent. In the seven-month totals, production of anhydrous ammonia and nitric acid still lagged behind the 1943 figures but with ammunition requirements stepped it may follow that production of these chemicals will be on a larger scale over the remainder of the year. Chlorine is being produced at a rate about 8 percent above the 1943 rate while the increase for caustic soda is around 11 percent. The greater part of caustic production is coming from the electrolytic branch and the relatively larger gain as compared with chlorine may be due to the fact that caustic is being recovered at some plants which formerly were concerned only with turning out chlorine.

While current data are not made public for titanium dioxide, the course of production is made public for white lead, lead oxide and zinc yellow and from the figures available, there has been a substantial gain in production of pigments in the year to date. White lead, in particular has made a fine showing with a rise of more than 25 percent over the comparable figures for last year.

In the vegetable oil field, much concern has been expressed over the government action in barring our ships from carrying cargo to this country from the Argentine. Last year with a large flaxseed crop raised in this country and also in Canada, our requirements for seed were met without importing much from outside. Ordinarily we have been heavy buyers of Argentine seed and as our seed crop this year and also that of Canada is much less than a year ago, we will need more from other countries and the Argentine is the logical place to look for supplies. However, the Argentine has not appeared any too eager to sell in our markets and the complications regarding shipping space may result in slowing up crushing operations in this country some time in the future. It will be possible to bring seed to this country in Argentine bottoms but they dock at New Orleans and the matter of rail shipments will be a factor in delivered costs.

In the consuming field, the difficulty in keeping cotton textile output up to requirements was emphasized by a WPA instruction to cotton mills in Alabama forbidding the dismantling of a group of mills and ordering them to produce a specified amount of textiles in the next three months. It was reported that the equipment from these mills was to be shipped to Brazil.

United States Production of Certain Chemicals

July 1944 and July 1943; Seven-Month Totals 1944 and 1943

Chemical and Basis	Units	July 1944	July 1943	Total for First Seven Months 1944	1943
Acetylene:					
For use in chemical synthesis.....	M cu. ft.	322,750	210,521	1,948,856	1,144,104
For commercial purposes.....	M cu. ft.	129,715	134,112	835,485	878,691
Ammonia:					
Synthetic anhydrous ammonia (100% NH ₃).....	Tons	42,927	44,376	301,189	315,354
Crushing powder (35-37% avail. Cl ₂).....	M lb.	3,093	3,928	33,776	35,509
Aluminum acetate (80% Ca (C ₂ H ₃ O ₂) ₃).....	M lb.	902	1,575	6,641	11,386
Aluminum arsenate (100% Ca (AsO ₄) ₃).....	M lb.	8,228	13,063	87,863	41,100
Aluminum carbide (100% CaC ₂).....	Tons	163,043	181,631	1,391,482	1,209,628
Aluminum hypochlorite (70% avail. Cl ₂).....	M lb.	1,091	1,020	8,149	6,378
Aluminum phosphate (100% CaH ₂ (PO ₄) ₃).....	M lb.	4,472	4,997	33,735	36,654
Carbon dioxide (100% CO₂):					
Liquid and gas.....	M lb.	181,506	27,916	1,170,037	144,172
Solid (dry ice).....	M lb.	164,789	134,137	1,297,141	1,245,556
Chlorine.....	Tons	109,657	98,409	736,049	681,669
Crucible green (C.P.).....	M lb.	413	692	3,610	4,498
Dichloric acid (100% HCl).....	Tons	31,639	27,707	210,030	193,731
Hydrogen.....	M cu. ft.	1,886,000	2,019,000	11,871,000	11,681,000
Sulfuric acid (acid and basic).....	M lb.	16,573	16,251	151,793	145,394
Sulfur dioxide, red (100% PhO ₂).....	M lb.	7,490	7,857	63,106	59,249
Ethanol:					
Natural (80% CH ₃ OH).....	Gal.	314,769	434,022	2,445,577	2,802,615
Synthetic (100% CH ₃ OH).....	M gal.	5,838	5,341	43,011	39,100
Hydrazine orange (C.P.).....	Lb.	122,527	145,399	839,710	1,023,350
Formic acid (100% HNO ₃).....	Tons	38,974	43,004	267,061	277,962
Sodium oxide (100% Na ₂ O).....	M gal.	110,225	9,306	158,616	155,714
Hydrogen.....	M cu. ft.	1,535,241	1,300,156	10,329,635	10,020,099
Phosphoric acid (80% H ₃ PO ₄).....	Tons	57,219	50,201	422,078	368,500
Sodium bicarbonate & chromate (100%).....	M lb.	508	674	4,533	6,028
Sodium chloride (100% KCl).....	Tons	108,709	87,206	742,241	7361,309
Sodium hydroxide (100% KOH).....	Tons	3,483	3,268	25,396	23,241
Soda ash (commercial sodium carbonate):					
Ammonia soda process (98-100% Na ₂ CO ₃)					
Total wet and dry.....	Tons	373,921	364,835	2,681,790	2,499,969
Finished light.....	Tons	201,828	198,197	1,465,140	1,280,480
Finished dense.....	Tons	121,159	108,659	849,591	810,631
Natural.....	Tons	15,032	13,475	102,778	91,957
Sodium bicarbonate (100% NaHCO ₃).....	Tons	11,808	13,177	83,196	98,902
Sodium bichromate & chromate (100%).....	Tons	6,829	6,740	48,927	47,884
Sodium hydroxide, liquid (100% NaOH):					
Electrolytic process.....	Tons	103,433	84,367	700,032	694,334
Soda process.....	Tons	58,113	55,878	397,749	378,452
Sodium phosphate:					
Monobasic (100% NaH ₂ PO ₄).....	M lb.	12,422	11,898	114,435	110,328
Dibasic (100% Na ₂ HPO ₄).....	Tons	4,600	4,025	27,659	23,799
Tribasic (100% Na ₃ PO ₄).....	Tons	1,837	1,628	139,497	134,610
Silica (water glass):					
Liquid (40° Baumé).....	Tons	190,154	186,254	1,513,963	1,444,503
Solid (all forms combined).....	Tons	19,247	19,618	156,438	146,917
Sulfuric acid:					
Boiler's salt and crude salt cake.....	Tons	166,625	164,449	1,398,819	1,397,772
Anhydrous (refined) (100% H ₂ SO ₄).....	Tons	15,229	15,638	141,253	133,263
Sulfur dioxide (100% SO ₂).....	M lb.	16,445	15,964	137,437	132,774
Sulfuric acid (100% H ₂ SO ₄): ¹					
Chamber process.....	Tons	249,775	242,420	1,868,001	1,777,101
Contact process.....	Tons	499,704	453,433	3,396,883	3,071,169
Not contact process.....	Tons	443,008	412,392	3,033,589	2,777,100
Sulfuric acid.....	Tons	5,901	5,285	48,531	38,621
Sulfuric acid (C.P.).....	M lb.	2,394	2,324	19,535	14,575

Data for this tabulation have been taken from the "Facts for Industry" series issued by the Bureau of the Census and the WPB Chemicals Bureau. Production figures represent primary production and do not include purchased or transferred material. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. ¹ July data not available. Figures given are for June and totals for the first six months only. ² Total wet and dry production including quantities converted for manufacture of caustic soda and sodium bicarbonate and quantities processed to finished light and finished dense soda ash. ³ Not including quantities converted to finished dense soda ash. ⁴ Data collected in cooperation with the Bureau of Mines. ⁵ Includes sulfuric acid of oleum grades. ⁶ Excludes spent acid. ⁷ Data given are for April and totals for first four months only. Data collected and compiled by Bureau of Mines.

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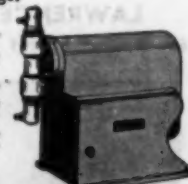


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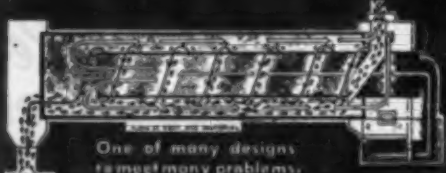
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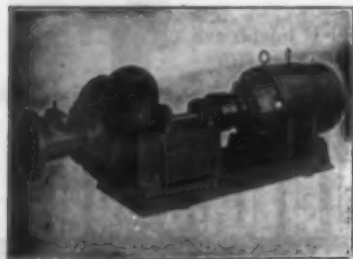
NOT AFFILIATED - ONE OFFICE, ONE PLANT - MINNEAPOLIS, MINNESOTA



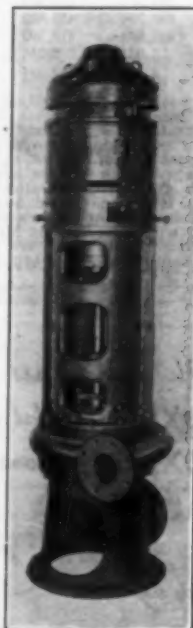
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LAWRENCE CENTRIFUGALS
FOR EVERY PUMPING DUTY

CHEM. & MET. Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

This month.....	109
Last month.....	109
October, 1943.....	109
October, 1942.....	109

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell for smaller quantities, prices are designated. Prices are quoted to October 12

INDUSTRIAL CHEMICALS

Acetone, tanks, lb.	\$0.07
Acid, acetic, 28%, bbl., 100 lb.	3.38 - 3.50
Boric, bbl., ton.	109.00 - 113.00
Citric, kegs, lb.	.20
Formic, cys., lb.	.104
Hydrofluoric, 30%, drums, lb.	.08
Lactic, 44%, tech., light, bbl., lb.	.073
Muriatic, 18", tanks, 100 lb.	1.03
Nitric, 36", carboys, lb.	.05
Oilum, tanks, wks., ton.	18.50 - 20.00
Oxalic, crystals, bbl., lb.	.11
Phosphoric tech., tanks, lb.	.04
Sulphuric, 60", tanks, ton.	13.00
Tartaric, powd., bbl., lb.	.704
Alcohol, amyl.	.131
From pentane, tanks, lb.	.101
Alcohol, butyl, tanks, lb.	.101
Alcohol, ethyl, denatured, 190 proof.	.145
No. 1 special, tanks, gal. wks.	.50
Alum, ammonia, lump, bbl., lb.	.041
Aluminum, sulphate, com. bags, 100 lb.	1.15 - 1.20
Ammonia, anhydrous, cyl., lb.	.16
tanks, lb.	.044
Ammonium carbonate, powd.	.094
Sulphate, wks., ton.	28.20
Amyl acetate, tech., from pentane, tanks, lb.	.145
Aqua ammonia, 26", drums, lb.	.024
tanks, ton.	65.00
Arsenic, white, powd., bbl., lb.	.04
Barium carbonate, bbl., ton.	65.00
Chloride, bbl., ton.	75.00
Nitrate, casks, lb.	.094
Blanc fix, dry, bags, ton.	60.00
Bleaching powder, f.o.b., wks., drums, 100 lb.	2.50 - 2.60
Borax, gran., bags, ton.	45.00
Calcium acetate, bags.	3.00
Arsenate, dr. lb.	.07
Carbide, drums, ton.	50.00
Chloride, flake, bags, del., ton.	18.50
Carbon bisulphide, drums, lb.	.05
Tetrachloride drums, gal.	.73
Chlorine, liquid, tanks, wks., 100 lb.	1.75 - 1.80
Copperas, bgs., f.o.b., wks., ton.	17.00
Copper carbonate, bbl., lb.	.194
Sulphate, bbl., 100 lb.	5.00
Cream of tartar, bbl., lb.	.57
Diethylene glycol, dr., lb.	.141
Epsom salt, dom., tech., bbl., 100 lb.	1.90 - 2.00
Ethyl acetate, tanks, lb.	.111
Formaldehyde, 40%, tanks, lb.	.032
Furfural, tanks, lb.	.094
Glauber's salt, bags, 100 lb.	1.05 - 1.10
Glycerine, c.p., drums, extra, lb.	.154
Lead:	
White, basic carbonate, dry casks, lb.	.081
Red, dry, csk., lb.	.09
Lead acetate, white crys., bbl., lb.	.12
Lead arsenate, powd., bag, lb.	.11
Lithopone, bags, lb.	.04
Magnesium carb., tech., bags, lb.	.09
Methanol, 95%, tanks, gal.	.58
Synthetic, tanks, gal.	.24
Phosphorus, yellow, cases, lb.	.23
Potassium bichromate, casks, lb.	.091
Chlorate, powd., lb.	.091
Hydroxide (s'atic potash) dr., lb.	.07
Muriate, 60% bags, unit.	.53
Nitrate, bbl., lb.	.05
Permanganate, drums, lb.	.19
Prussiate, yellow, casks, lb.	.17
Sol ammoniac, white, casks, lb.	.0515
Salsoda, bbl., 100 lb.	1.00 - 1.05
Salt cake, bulk, ton.	15.00
Soda ash, light, 55%, bags, contract, 100 lb.	1.05
Dense, bags, 100 lb.	1.15
Soda, caustic, 70% solid, drums, 100 lb.	2.30 - 2.40
Acetate, del., bbl., lb.	.05
Bicarbonate, bbl., 100 lb.	1.70 - 1.80
Bichromate, casks, lb.	.071
Bisulphate, bulk, ton.	10.00
Bisulphite, bbl., lb.	.03

CHEM. & MET.

Weighted Index of Prices for
OILS & FATS

Base = 100 for 1937

This month	145.04
Last month	145.04
October, 1943	145.55
October, 1942	140.85

Chlorate, kegs, lb.	.061	.064
Cyanide, cases, dom., lb.	.14	.15
Fluoride, bb., lb.	.07	.08
Hyposulphite, bbl., 100 lb.	2.40	2.50
Metasilicate, bbl., 100 lb.	2.50	2.65
Nitrate, bulk, 100 lb.	1.35	
Nitrite, casks, lb.	.061	.07
Phosphate, tribasic, bags, lb.	2.70	
Prussiate, yel. bags, lb.	.091	.10
Sulfate, 40°, dr., wks., 100 lb.	.80	.85
Sulphide, bbl., lb.	.024	
Sulphite, crys., bbl., lb.	.024	.021
Sulphur, crude at mine, long ton	16.00	
Dioxide, cyl., lb.	.07	.08
Tin crystals, bbl., lb.	.391	
Zinc chloride, gran., bbl., lb.	.051	.06
Oxide, lead free, bags, lb.	.071	
Oxide, 5% leaded, bags, lb.	.071	
Sulphate, bbl., ewt.	3.85	4.00

OILS AND FATS

Castor oil, No. 3 bbl., lb.	\$0.131	\$0.141
Chinawood oil, tanks, lb.	.381	
Cocoonut oil, ceylon, dr. N.Y., lb.	.0889	
Corn oil crude, tanks (f.o.b. mill), lb.	.121	
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.121	
Linseed oil, raw, ear lots, bbl., lb.	.151	
Palm, casks, lb.	.087	
Peanut oil, crude, tanks (mill), lb.	.13	
Rapeseed oil, refined, bbl., lb.	nom.	
Soy bean, tank, lb.	.111	
Menhaden, light pressed, dr., lb.	.116	
Crude, tanks (f.o.b. factory) lb.	.089	
Grease, yellow, loose, lb.	.081	
Oleo stearine, lb.	.091	
Oleo oil, No. 1, lb.	.11	
Red oil, distilled, bbl., lb.	.12	
Tallow extra, loose, lb.	.081	

COAL-TAR PRODUCTS

Alpha-naphthol, crude, bbl., lb.	\$0.52	\$0.55
Alpha-naphthylamine, bbl., lb.	.32	.34
Aniline oil, drums, extra, lb.	.15	.16
Aniline salts, bbl., lb.	.22	.24
Benzaldehyde, U. S. P., dr., lb.	.85	.95
Benzidine base, bbl., lb.	.70	.75
Benzoin acid, U. S. P., kgs., lb.	.54	.56
Benzol, 90%, tanks, works, gal.	.15	
Benzyl chloride, tech., dr., lb.	.23	.25
Beta-naphthol, tech., drums, lb.	.23	.24
Cresol, U. S. P., dr., lb.	.11	
Cresylic acid, dr., wks., gal.	.81	.83
Diphenyl, bbl., lb.	.15	
Diethylaniline dr., lb.	.40	.45
Dinitrochlorol, bbl., lb.	.18	.19
Dinitrophenol bbl., lb.	.22	.23
Dip oil, 15%, dr., gal.	.23	.25
Diphenylamine, dr. f.o.b. wks., lb.	.60	
H acid, bbl., lb.	.45	.60
Hydroquinone, bbl., lb.	.90	
Naphthalene flake, bbl., lb.	.07	.071
Nitrobenzene, dr., lb.	.08	.09
Paracresol, bbl., lb.	.41	
Para-nitraniline, bbl., lb.	.47	.49
Phenol, U. S. A., drums, lb.	.101	.11
Picric acid, bbl., lb.	.35	.40
Pyridine, dr., gal.	1.70	1.80
Resorcinol, tech., kegs, lb.	.75	.80
Silicylic acid, tech., bbl., lb.	.33	.40
Solvent naphtha, w.w., tanks, gal.	.27	
Tolidine, bbl., lb.	.86	.88
Toluol, drums, works, gal.	.33	
Xylol, com., tanks, gal.	.26	

MISCELLANEOUS

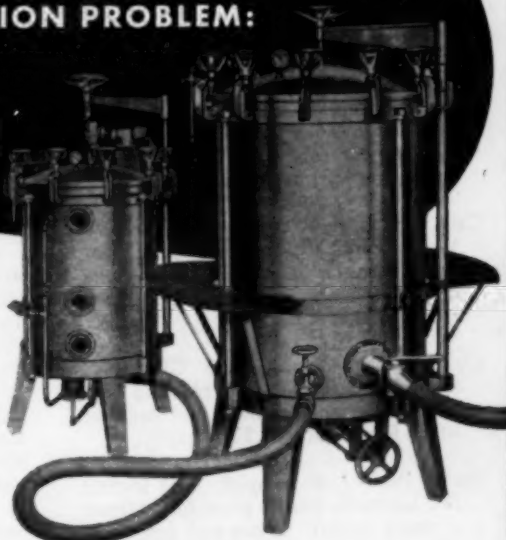
Casain, tech., bbl., lb.	\$0.18	\$0.24
Dry colors		
Carbon gas, black (wks.), lb.	.0335	.30
Prussian blue, bbl., lb.	.36	.37
Ultramarine blue, bbl., lb.	.11	.26
Chrome green, bbl., lb.	.211	.30
Carmines, red, tins, lb.	4.60	4.75
Para toner, lb.	.75	.80
Vermilion, English, bbl., lb.	2.75	2.80
Chrome, yellow, C. P., bbl., lb.	.141	.151
Gum copal, congo, bags, lb.	.09	.30
Manila, bags, lb.	.09	.15
Demar, Batavia, cases, lb.	.10	.22
Kauri, cases, lb.	.18	.60
Stagnosite, calc., ton	64.00	
Sumie stone, lump, bbl., lb.	.05	.07
Stos, H., 100 lb.	6.47	
Shellac, orange, fine, bags, lb.	.39	
Bleached, bonedry, bags, lb.	.39	
T. N. bags, lb.	.31	
Serpentine, gal.	.891	

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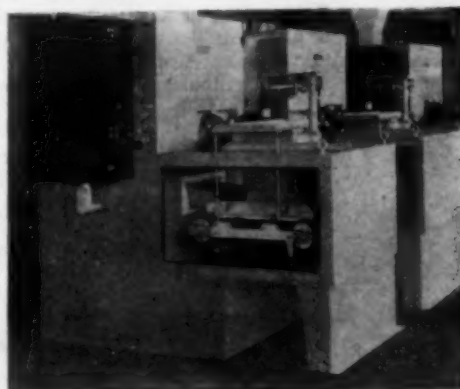
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NEW CONSTRUCTION

PROPOSED WORK

Calif., Los Angeles—Ferro Enamel Corp., 4150 East 56th St., Cleveland, O., plans to construct a plant here. Estimated cost will exceed \$150,000.

Calif., Newhall—Newhall Refinery, c/o W. D. Parks, 917 Newhall Ave., plans to reconstruct its oil refinery recently destroyed by fire. Estimated cost will exceed \$40,000.

Ga., Atlanta—Owens-Illinois Glass Co., Ohio Bldg., Toledo, O., plans to construct a warehouse and office building here. Estimated cost \$2,000,000.

Idaho, Paul—J. R. Simplot, 1824 Everett St., Caldwell, Idaho, plans to construct a starch factory. Estimated cost \$60,000.

Ky., Midway—Park & Tilford Distillers, Inc., Starks Bldg., Louisville, Ky., plans to construct a new plant here and install equipment. Estimated cost \$250,000.

Mass., Charlestown—Davidson Rubber Co., 50 Brighton St., will construct a 1 story, 35 x 77 ft. factory and a 1 story, 50 x 150 ft. office building. Alonzo B. Reed, 88 Broad St., Boston, Archt. Estimated cost \$55,000.

Mich., Detroit—United States Rubber Co., 6600 Jefferson Ave., plans to construct 4 story, 174 x 180 ft. and 3 story, 86 x 165 ft. additions to its plant here. Estimated cost \$3,015,775.

Mont., Laurel—Independent Refining Co., Div. of Farmers Union Central Exchange, 12 Third St. N.W., Great Falls, P. A. Thompson, Mgr. Refinery Div., plans to construct an addition to its refinery, including new cracking furnace and cracking plant, etc. Estimated cost \$250,000.

Nev., Las Vegas—Basic Magnesium, Inc., Las Vegas, plans to construct a research foundry. Estimated cost \$350,000.

N. J., Garfield—Heyden Chemical Co., 290 River Rd., will construct a 3 story, 45 x 164 ft. factory.

Tex., Houston—Shell Oil Co., Inc., Shell Bldg., plans to construct a fluid catalytic high octane gasoline refining plant at Deere Park. Estimated cost \$11,000,000.

CONTRACTS AWARDED

Calif., Oakland—Alloychemical Corp., de Young Bldg., San Francisco, will convert old Southern Pacific powerhouse on Fruitvale Ave., into modern tartrate and

	Current Projects		Cumulative 1944	
	Proposed Work	Contracts	Proposed Work	Contracts
New England.....	\$25,000	\$915,000	\$905,000	\$2,807,000
Middle Atlantic.....	40,000	2,680,000	7,267,000	13,235,000
South.....	2,250,000	1,000,000	14,457,000	25,478,000
Middle West.....	3,016,000	390,000	20,582,000	29,866,000
West of Mississippi.....	11,250,000	5,275,000	43,395,000	30,398,000
Far West.....	600,000	1,750,000	7,899,000	14,367,000
Canada.....			9,512,000	6,401,000
Total.....	\$17,211,000	\$12,010,000	\$104,017,000	\$122,552,000

tartaric acid manufacturing plant. Work will be done by separate contracts. Estimated cost \$750,000.

Calif., Richmond—Oronite Chemical Co., subsidiary of Standard Oil Co., Russ Bldg., San Francisco, has awarded the contract for the construction of phthalic anhydride plant, a basic stock for paints and finishes, to E. B. Badger & Sons Co., 75 Pitt St., Boston, Mass. Estimated cost \$1,000,000.

Conn., Naugatuck—Naugatuck Chemical Co., Div. of U. S. Rubber Co., Elm St., has awarded the contract for the construction of two 2 story factory buildings to E. & F. Construction Co., 94 Wells St., Bridgeport. Project will be financed by Defense Plant Corp., Wash., D. C. Estimated cost \$700,000.

Conn., Naugatuck—Naugatuck Chemical Co., Div. of U. S. Rubber Co., Elm St., has awarded the contract for 2 and 3 story, 57 x 103 ft. factory buildings to W. J. Megin, Inc., 51 Elm St. Estimated cost \$80,000.

Ind., Zionville—Pittman-Moore Co., 1200 Madison Ave., Indianapolis, has awarded the contract for additions to its pharmaceutical manufacturing plant here to Carl M. Geupel Construction Co., 923 Hume-Mansur Bldg., Indianapolis. Estimated cost \$75,000.

Kan., Topeka—Defense Plant Corp., Wash., D. C., has awarded the contract for the construction of a tire plant here to be operated by Goodyear Tire & Rubber Co., of Kansas, Inc., subsidiary of Goodyear Tire & Rubber Co., Akron, O. to John A. Johnson & Sons, 269 41st St., Brooklyn, N. Y. Estimated cost \$4,500,000.

Mass., Brighton—New England Rendering Co., Abbatior Grounds, has awarded the contract for alterations and additions to its glue plant to Sawyer Construction Co., 31 St. James Ave., Boston. Estimated cost \$60,000.

N. J., Linden—Standard Oil Co. of New Jersey, Bayway Refinery, will construct an alcohol storage tank with its own forces. Estimated cost \$40,000.

N. J., Bound Brook—T. C. Calco Chemical Corp., Bound Brook Rd., has awarded the contract for a 1 story, 200

x 200 ft. warehouse building to E. De Christofer, 21 High St. Estimated cost \$100,000.

N. Y., Hicksville—Glassfloss Corp., 155 East 44th St., New York 17, N. Y., has awarded the contract for the construction of a manufacturing building to Austin Co., 19 Rector St., New York 6, N. Y. Project will be financed by Defense Plant Corp., Wash., D. C. Estimated cost \$2,500,000.

O., Cleveland—Cleveland Graphite Bronze Co., 16800 St. Clair Ave., has awarded the contract for an addition to its plant to Albert M. Higley Co., 2036 East 22nd St. Estimated cost \$275,000.

Okl., Ponca City—Continental Oil Co. will reconstruct portion of gasoline plant recently destroyed by fire. Work will be done by force account and subcontracts. Estimated cost \$75,000.

Pa., New Kensington—Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, has awarded the contract for a 1 and 2 story research laboratory to The Trimble Co., 1719 Pennsylvania Ave. N.S., Pittsburgh.

R. I., Bristol—U. S. Rubber Co., 500 Wood St., has awarded the contract for a 3 story, 50 x 100 ft. factory to H. V. Collins, 7 Dyer St., Providence. Estimated cost \$75,000.

Tex., Katy—Humble Oil & Refining Co., Humble Bldg., Houston, has awarded the contract for recycling plant addition to Hudson Engineering Co., 2711 Danville St., Houston. Estimated cost \$700,000.

Va., Front Royal—General Chemical Co., 40 Rector St., New York, N. Y., has awarded the contract for the construction of a chemical plant here to F. H. McGraw Co., 780 Windsor St., Hartford, Conn. Project will be financed by Defense Plant Corp., Wash., D. C. Estimated cost will exceed \$1,000,000.

Wis., Merrimac—U. S. Eng., Milwaukee, Wis., has awarded the contract for buildings at Badger Ordnance Plant to National Builders, Inc., Foshay Tower, Minneapolis, Minn., at \$234,550. Hercules Powder Co., Wilmington, Del. operator.

EXHIBITORS

	Booth No.		Booth No.
Acadia Synthetic Products, 4115 West Ogden Ave., Chicago, Ill.	85	Johns-Manville Corporation, 22 East 40th St., New York 16, N. Y.	21
Ace Glass, Inc., Vineland, New Jersey	117	Johnson Corporation, 826 Wood St., Three Rivers, Michigan	206-207
Alox Corporation, 3943 Buffalo Ave., Niagara Falls, N. Y.	143-144		
American Air Filter, Inc., 215 Central Ave., Louisville 9, Ky.	171-172	Kewaunee Mfg. Co., End of South Center St., Adrian, Mich.	8
American Cyanamid & Chem. Corp., 30 Rockefeller Plaza, New York 20, N. Y.	192-193	Kidde & Co., Walter, 140 Cedar St., New York 6, N. Y.	185
American Foundry Equipment Co., 555 Byrkit St., Mishawaka, Indiana	47	Kimble Glass Company, Vineland, New Jersey	119
American Instrument Co., 8010 Georgia Ave., Silver Springs, Md.	107	Knight, Maurice A., Kelly Avenue, Akron 9, Ohio	149-150
American Photocopy Equip. Co., 2849 North Clark St., Chicago 14, Ill.	152	Kold-Hold Manufacturing Company, 424 No. Grand Ave., Lansing 4, Michigan	95
American Resinous Chemicals Corp., Peabody, Massachusetts	30		
Amerisil Co., Inc., 60 Wall Tower, New York 5, N. Y.	229	Laboratory Equipment Corporation, 720 East Main St., Benton Harbor, Michigan	141
Anelsberger Bros., 3505-11 Elston Ave., Chicago 18, Ill.	181	Laboratory Furniture Co., Inc., 37-18 Northern Boulevard, Long Island City, N. Y.	45-48
Angal & Co., H. Reeve, Inc., 7-11 Spruce St., New York 7, N. Y.	118	Lafine & Co., Arthur S., 121 W. Hubbard St., Chicago, Illinois	232
Armour and Co., 1355 West 31st St., Chicago 9, Ill.	71	Lapp Insulator Co., LeRoy, New York	121
Armstrong Machine Works, Three Rivers, Wisconsin	205	Leader Iron Works, Inc., 2110 N. Jasper St., Decatur, Ill.	75
Atlas Powder Co., 999 Market St., Wilmington 99, Delaware	130	Link-Belt Company, 307 N. Michigan Avenue, Chicago 1, Ill.	52-53
Automatic Transportation Co., 101 West 87th St., Chicago 20, Ill.	218	Loeb Equipment Supply Co., 910 North Marshfield Ave., Chicago, Ill.	32-33
		Lukens Steel Company, Coatsville, Pennsylvania	122
Bareco Oil Company, P. O. Box, 2009, Tulsa 2, Oklahoma	179		
Barnstead Still & Sterilizer Co., Inc., 2 Lanaville Terrace, Forrest Hills, Boston 30, Massachusetts	20	Mallinckrodt Chemical Works, 3600 N. Second St., St. Louis 7, Mo.	167-168
Barrett-Cravens Co., 3255 W. 30th St., Chicago 23, Illinois	24	Marathon Paper Mills Co., Rothschild, Wisconsin	78
Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio	84-87	Marsh Stencil Machine Company, Belleville, Illinois	116
Bemis Bro. Bag Co., 408 Pine St., St. Louis 2, Missouri	155-156	Mayer & Oswald, Inc., 37 W. Van Buren St., Chicago, Ill.	126
Bennett Mfg. Co., 14400 Princeton Ave., Chicago 27, Ill.	140	McGraw-Hill Publishing Co., 330 West 42nd St., N. Y. 18, N. Y.	111
Brown Instrument Co., Germantown P. O., Phila., Pa.	235-236-237	Merco Nordstrom Valve Company, 400 N. Lexington Ave., Pittsburgh 24, Pa.	38-39
Buehler, Ltd., 165 West Wacker Drive, Chicago 1, Ill.	3-4	Metal Glass Products Co., Belding, Michigan	137-138
Buell Engineering Co., Inc., 20 Pine St., New York 5, N. Y.	195	Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8, Pa.	239
Buffalo Foundry & Machine Co., 1543 Fillmore Ave., Buffalo 11, N. Y.	43-44	Monsanto Chemical Company, 1700 So. Second St., St. Louis 4, Mo.	219-220
Builders Iron Foundry, Inc., 9 Coddling St., Providence 1, R. I.	4-7		
Bump Pump Co., LaCrosse, Wisconsin	221-222	National Carbox Company, Carbon Products Division, 30 East 42nd St., New York 17, N. Y.	22-23
		National Engineering Co., 549 W. Washington St., Chicago 40, Ill.	48-49
Carrier-Stephens Co., Lansing, Mich.	182	National Starch Products, Inc., 270 Madison Ave., New York 16, N. Y.	88-87
Celanese Celluloid Corporation, 180 Madison Ave., New York 16, N. Y.	105-106	National Technical Laboratories, 820 Mission St., So. Pasadena, Calif.	54-55
Central Scientific Company, 1700 Irving Park Blvd., Chicago, Illinois	91	Neville Company, Pittsburgh 25, Pennsylvania	61
Chemical Developments Corp., 314 West First St., Dayton 2, Ohio	194	Niagara Filter Corp., 3080 Main St., Buffalo 14, N. Y.	217
Chemical Industries Magazine, Tradepress Publishing Corp., 522 5th Ave., New York 18, N. Y.	128-129		
Chemical & Metallurgical Engineering, 330 W. 42nd St., New York 18, N. Y.	111	Ohio Chemical & Mfg. Co., 745 Hanna Bldg., Cleveland 15, Ohio	67
Chicago Apparatus Company, 1735 N. Ashland Ave., Chicago, Ill.	101	Ohio Steel Foundry Co., Springfield, Ohio	169-170
Chicago Pump Co., 2300 W. Wolfram St., Chicago 18, Ill.	123	Olson Filtration Engineers, 1624 N. Killebrew, Chicago, Illinois	183
Commercial Solvents Corporation, Terre Haute, Indiana	40	Owens-Corning Fiberglas Corp., Nichols Bldg., Toledo 1, Ohio	233-234
Container Company, 975 Glenn St., Van Wert, Ohio	103-104		
Corning Glass Works, Corning, New York	113-114	Paper & Industrial Appliances, Inc., 122 E. 42nd St., New York 17, N. Y.	98-99
		Patterson-Kelley Co., Inc., East Stroudsburg, Pennsylvania	162
Darco Corporation, 60 E. 42nd St., New York	130	Perrumth Co., 330 W. 42nd St., New York 18, N. Y.	115
deBeers & Associates, F. M., 20 N. Wacker Drive, Chicago, Ill.	80	Peterson & Company, Inc., Leonard, 122 W. Fullerton Ave., Chicago 14, Ill.	161
Davison Chemical Corporation, 20 Hopkins Pl., Baltimore 3, Md.	163-164-165	Paudler Co., 89 East Avenue, Rochester 4, N. Y.	70
De Laval Separator Co., 165 Broadway, New York 6, N. Y.	158	Phillips Petroleum Company, Bartlesville, Oklahoma	94
Denver Equipment Co., 1400-17th St., Denver 17, Colo.	72-73	Philosophical Library, 15 East Fortieth Street, New York 16, N. Y.	231
Dicalite Co., 756 South Broadway, Los Angeles 14, Calif.	144	Podbielniak, Inc., 8312 South Chicago Ave., Chicago 17, Ill.	135
Dietert Co., Harry W., 9330 Roselawn Ave., Detroit 4, Michigan	42	Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.	209-210
Dorr Co., 570 Lexington Ave., New York 22, N. Y.	96-97	Pressed Steel Tank Co., 1445 South 64th St., Milwaukee 14, Wisconsin	246
Dow Chemical Company, 1160 E. Main St., Midland, Michigan	81-82-83-84	Productive Equipment Corporation, 2926 West Lake St., Chicago 12, Ill.	127
Durametallic Corporation, 2104 Factory St., Kalamazoo 24F, Michigan	1	Pulverizing Machinery Co., Chatham Rd., Summit, New Jersey	18-19
Duriron Company, Inc., 450 North Findlay St., Dayton 1, Ohio	14-17	Purman Publishing Company, 737 N. Michigan Ave., Chicago 11, Ill.	108
Emery-Carpenter Container Co., 4600 Carew Tower, Cincinnati, Ohio	124	Reichhold Chemicals, Inc., 401 Woodward Heights Blvd., Detroit 20, Michigan	58-59
Emulsol Corporation, 59 E. Madison St., Chicago, Ill.	139	Reinhold Publishing Co., 330 W. 42nd St., New York, N. Y.	134
Eral Engineering Corporation, New York City 19, N. Y.	79	Reynolds Molded Plastics Div., Continental Can Company, Inc., Box 427, Cambridge, Ohio	173-174-175
Eutectic Welding Alloys Company, 40 Worth St., New York 13, N. Y.	125	Ross & Rowe, 75 Varick St., New York 13, N. Y.	184
Fantsteel Metallurgical Corporation, 2200 Sheridan Rd., North Chicago, Ill.	110	St. Regis Paper Co., Lincoln Bldg., 230 Park Ave., New York 17, N. Y.	56-57
Federal Classifier Systems, Inc., 127 North Dearborn St., Chicago 2, Ill.	191	Sargent & Co., E. H., 155 E. Superior St., Chicago, Ill.	51
Filter Paper Co., 57 East 24th St., Chicago 16, Ill.	36-37	Scharr & Co., 754 W. Lexington St., Chicago 7, Ill.	10
Fisher Scientific Co., 711 Forbes St., Pittsburgh 19, Pa.	100	Scheible Company, Claude B., 2827-25th St., Detroit 16, Michigan	145
Fitzpatrick Company, W. J., 1001 West Washington St., Chicago 7, Ill.	31	Scientific Glass Apparatus Co., 49 Ackerman St., Bloomfield, N. J.	208
Foxboro Co., 46 Neponset Ave., Foxboro, Mass.	178	Selas Company, Scientific Equipment Div., Erie Ave. & D St., Philadelphia 34, Pa.	50
		Sharples Corporation, 23rd & Westmoreland Streets, Philadelphia 40, Pa.	76
General American Process Equip. Div., General American Transportation Corporation, 451 Baxter Ave., Louisville 4, Ky.	62-63-64-65	Sheldon Co., E. H., 720 Vims St., Muskegon, Michigan	12-13
General Ceramics Co., Keasbey, New Jersey	160-166	Simplicity Engineering Co., Durand, Michigan	66
Glasco Products, Inc., 20900 St. Clair Ave., Cleveland 17, Ohio	159	Silver Steel Casting Company, 1675 South 43rd St., Milwaukee 14, Wisc.	34-35
Glycerine Producers' Association, 381 Fourth Ave., New York, N. Y.	11	Socony Vacuum Oil Co., Inc., 26 Broadway, New York 4, N. Y.	241-242
Glyco Products Co., 26 Court St., Brooklyn 2, N. Y.	151	Sparker Mfg. Co., Mundelein, Illinois	79
Graver Tank & Mfg. Co., Inc., East Chicago, Indiana	112	Sperry & Co., D. R., Batavia, Illinois	147
Gray-Mills Co., 1948-52 Ridge Ave., Evanston, Ill.	77	Standard-Knapp Corp., 221 N. LaSalle St., Chicago 1, Ill.	180
Great Western Mfg. Co., Leavenworth, Kansas	204		
Gump Co., B. F., 431 South Clinton St., Chicago 7, Ill.	28-29	Triangle Package Machinery Co., 906-24 N. Spaulding Ave., Chicago, Ill.	26-27
		Tri-Clover Machine Co., Kenosha, Wisconsin	157
Heering Co., Inc., D. W., 205 West Wacker Dr., Chicago 6, Ill.	148	Union Bag & Paper Corporation, 233 Broadway, New York 7, N. Y.	154
Hamilton Mfg. Co., Two Rivers, Wisconsin	120	U. S. Stoneware Company, 411 E. Market St., Akron 9, Ohio	227-228
Hammond Drierite Co., W. A., 120 Dayton Ave., Xenia, Ohio	142		
Hasco Valve & Machine Co., 1819 W. St. Paul Ave., Milwaukee, Wisc.	109	Valvoline Oil Co., Fifth & Butler Sts., Cincinnati, Ohio	216
Haveg Corporation, Newark, Delaware	74	Victor Chemical Works, 141 West Jackson Blvd., Chicago 4, Ill.	92-93
Hercules Powder Company, 900 Market St., Wilmington 99, Delaware	133		
Hills-McCanna Co., 3025 North Western Ave., Chicago 18, Ill.	67-68	Wallace & Tiernan, Inc., Box 178, Newark, New Jersey	240
		Waukesha Foundry Company, Waukesha, Wisconsin	90
Illinois Electric Porcelain Co., Macomb, Illinois	14-15	Weich Manufacturing Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.	136
Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago, Illinois	5	Wheelco Instruments Co., 847-51 West Harrison St., Chicago 7, Ill.	2
Illinois Water Treatment Co., 840 Cedar St., Rockford, Illinois	131	Wilson Chemical Feeders, Inc., 205 Clinton St., Buffalo 5, New York	40
Industrial & Engineering Chemistry, 1155 Sixteenth Street, N. W., Washington, D. C.	132	Worthington Pump and Machinery Corp., Harrison, New Jersey	153
Industrial Instruments, Inc., 17 Pollock Ave., Jersey City 5, N. J.	25		
Intra-Red Engineers & Designers, 1433 East Fortieth Street, Cleveland, Ohio	199		
Ingersoll Steel & Disc, Div., Borg-Warner, 310 S. Michigan Ave., Chicago 4, Ill.	41		
Interscience Publishers, Inc., 215 Fourth Avenue, New York 3, N. Y.	102		

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